



6900 Tylersville Road, Suite A
Mason, Ohio 45040
P 513.336.6600
F 513.336.9365
www.bayerbecker.com

May 16, 2012

Mrs. Teresa Barnes
Butler County Engineer's Office
1921 Fairgrove Avenue
Hamilton, Ohio 45011



Re: Voice of America Park

Dear Mrs. Barnes:

Enclosed please find one copy the revised detention calculations, storm sewer calculations, and two copies other of the revised site improvement drawings. Changes have been made per your review comments received on May 2, 2012 via email and the following:

Page C4.0

1. The fabricated reducers have been removed and manholes 9b and 10b have been added.

Page C4.1

2. Proposed grading on the South end of the fields has been revised so that no low point will be created.

Page C4.2

3. The proposed fence to be constructed with Butler Warren Road improvements has been added.
4. In an email sent on February 10, 2012, we asked Steve Hartke to have the path improvement plans changed so that the inverts of the southern 24" pipe would be changed to 886.70 (inlet) and 886.53 (outlet). We will follow up with Steve to make sure that the inverts were changed.
5. Depending on the timing of construction for the park and the proposed path, a couple of storm sewers under the proposed path may not be needed. At this time we do not the construction timing for the park improvements.
6. The spillway for lake #3 has been revised and a proposed ditch has been added to direct to water to the culvert pipe under Butler Warren Road.
7. Outlet for Lake #3 has been revised.
8. The top of grate elevation for Structure 30 (lake #3 outlet structure) has been corrected on all sheets.

General

9. The CN value for post-construction drainage area 3 has been corrected and all calculations for lake #3 have been revised.
10. The storm sewer calculations have been revised to carry the pipe between structures 1 and 2 throughout the calculations.
11. All storm inverts on the plan sheets have been revised to match the storm sewer calculations.
12. Storm sewer pipe sizing for section 18-19 and 20-21-22 have been added to the storm calculations.

Please review the enclosed and contact us should you have any questions or need any additional information. If I can be of any assistance, please call me.

Sincerely,

Gregory J Koch, P.E.

Cc: John Granville, Butler County Metroparks

CIVIL & TRANSPORTATION ENGINEERING

LANDSCAPE ARCHITECTURE

PLANNING

SURVEYING

BAYER BECKER
6900 Tylersville Road, Suite A
Mason, Ohio 45040
(513) 336-6600

STORM SEWER CALCULATIONS

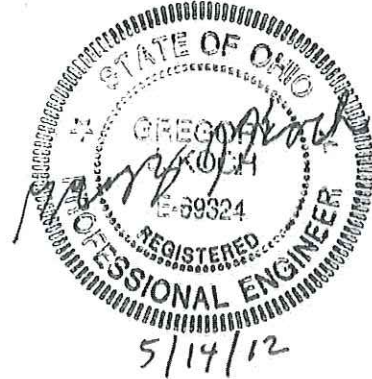
FORMULAE USED
 $Q = AC * I$ (required)
 $V_p = (1.486 / n) * R^{2/3} * S^{1/2}$
 $Q_p = A_p * V_p$
 $R = (\text{Pipe Dia.} / 4)$

Designed By: GJK
Reviewed By:
Date: 4/3/2012
Revised date: 5/14/2012

Project Name: Voice of America Park, Phase 1

Sheet: Job # 07M056.006

LOCATION	TOPOGRAPHY				TIME				DESIGN				TIME				REMARKS						
	From	To	Area Number	Acres	"C" Value	"AC" for Area	"AC" Accumulate	Time To Inlet "T _i " (minutes)	Time In Pipe "T _p " (minutes)	Concentration "T _c " (minutes)	Intensity "I" (10 Year Storm Event)	"Q" Required (c.f.s.)	Pipe Size (inches)	"n" Value	Slope In %	Velocity (ft. / sec)	"Q" Provided (c.f.s.)	Length of Pipe (feet)	Time In Pipe "T _p " (minutes)	Inlet Invert Elev.	Outlet Invert Elev.		
1	2	1	1.50	0.50	0.75	0.75	0.75	10.0	10.0	10.0	5.15	3.86	15	0.016	1.10	4.49	5.50	124.00	0.5	888.68	887.32		
1a	2	1a	2.57	0.50	1.29	2.04	2.04	10.0	10.0	10.0	5.15	10.48	27	0.016	0.30	3.47	13.78	44.00	0.2	886.70	886.57		
2	3	2	2.00	0.50	1.00	3.04	3.04	10.0	0.5	10.5	5.08	15.42	30	0.016	0.30	3.72	18.25	67.00	0.3	886.07	885.87		
3	4	3	2.36	0.50	1.18	4.22	4.22	10.5	0.3	10.8	5.04	21.22	36	0.016	0.30	4.20	29.68	176.00	0.7	885.37	884.84		
4	5	4	1.11	0.50	0.56	4.77	4.77	10.8	0.7	11.5	4.93	23.53	36	0.016	0.30	4.20	29.68	190.00	0.8	884.84	884.27		
5a	5	5a	3.30	0.50	1.65	1.65	1.65	12.0	1.6	12.0	4.86	8.01	24	0.016	0.50	4.14	13.00	385.00	1.6	886.36	884.44		
5	6	5	0.94	0.70	0.66	7.08	7.08	12.0	1.6	13.6	4.65	32.92	36	0.016	0.45	5.14	36.35	234.00	0.8	884.27	883.21		
6a	6	6a	2.91	0.50	1.46	1.46	1.46	12.0	1.6	12.0	4.86	7.07	24	0.016	0.50	4.14	13.00	385.00	1.6	886.36	884.44		
6	7	6	1.30	0.75	0.98	9.51	9.51	13.6	1.6	15.1	4.46	42.42	42	0.016	0.35	5.03	48.36	215.00	0.7	882.71	881.96		
7	8	7	0.50	0.50	0.25	9.76	9.76	15.1	0.7	15.8	4.38	42.74	42	0.016	0.35	5.03	48.36	84.00	0.3	881.96	881.67	N Pool = 881.50	
9a	9b	8a	3.75	0.50	1.88	1.88	1.88	12.0		12.0	4.86	9.11	24	0.016	0.50	4.14	13.00	365.00	1.5	889.93	888.11		
9b	9	8b	3.76	0.50	1.88	3.76	3.76	12.0	1.5	13.5	4.66	17.50	30	0.016	0.50	4.80	23.57	381.00	1.3	887.61	885.70		
9	10					3.76	3.76	13.5	1.3	14.8	4.50	16.89	30	0.016	0.50	4.80	23.57	234.00	0.8	885.70	884.53		
10a	10b	8c	3.24	0.50	1.62	1.62	1.62	12.0		12.0	4.86	7.87	24	0.016	0.50	4.14	13.00	365.00	1.5	889.93	888.11		
10b	10	8d	3.05	0.50	1.53	3.15	3.15	12.0	1.5	13.5	4.66	14.66	30	0.016	0.50	4.80	23.57	381.00	1.3	887.61	885.70		
10	11					6.90	6.90	14.8	0.8	15.6	4.40	30.38	36	0.016	0.50	5.42	38.32	435.00	1.3	884.03	881.86	N Pool = 881.50	
12	13	9	0.37	0.40	0.15	0.15	0.15	10.0		10.0	5.15	0.76	12	0.016	2.50	5.83	4.58	63.00	0.2	884.20	882.63	N Pool = 881.50	
14	15	10	1.65	0.60	0.99	0.99	0.99	10.0		10.0	5.15	5.10	15	0.016	3.30	7.77	9.53	60.00	0.1	884.00	882.02	N Pool = 881.50	
48	49	11	0.72	0.85	0.61	0.61	0.61	10.0		10.0	5.15	3.15	12	0.016	1.25	4.12	3.24	40.00	0.2	894.00	893.50		
50	51	12	0.60	0.70	0.42	1.03	1.03	10.0		10.0	5.15	5.32	15	0.016	1.00	4.28	5.25	24.00	0.1	892.50	892.26		
52	53	13	0.50	0.50	0.25	1.28	1.28	10.0		10.0	5.15	6.60	18	0.016	0.80	4.32	7.63	40.00	0.2	889.72	889.40		
16	17	14	1.67	0.60	1.00	2.28	2.28	10.0		10.0	5.15	11.77	24	0.016	0.50	4.14	13.00	52.00	0.2	883.75	883.49	"AC" Accumulate=Sum of Areas 11,12,13, & 14	
54	55	15	0.10	0.70	0.07	0.07	0.07	10.0		10.0	5.15	0.36	12	0.016	1.00	3.69	2.89	40.00	0.2	889.80	889.40		
17	18	16	1.70	0.40	0.68	3.03	3.03	10.0	0.2	10.2	5.12	15.53	30	0.016	0.50	4.80	23.57	70.00	0.2	882.99	882.64	"AC" Accumulate=Sum of Areas 11,12,13,14,15 & 16	
18	19	17	1.28	0.40	0.51	3.55	3.55	10.2	0.2	10.5	5.08	18.02	30	0.016	0.50	4.80	23.57	89.00	0.3	882.64	882.20	N Pool = 881.50	
56	57	18	2.82	0.40	1.13	1.13	1.13	10.0		10.0	5.15	5.81	18	0.016	0.70	4.04	7.14	36.00	0.1	888.45	888.20		
58	59	19	5.81	0.40	2.32	2.32	2.32	10.0		10.0	5.15	11.97	24	0.016	0.50	4.14	13.00	36.00	0.1	888.11	887.93		
20																							
21	22	21	1.85	0.40	0.74	0.74	0.74	10.0		10.0	5.15	3.81	12	0.016	3.60	6.99	5.49	55.69	0.1	885.70	883.70	"AC" Accumulate=Sum of Areas 18,19,20 & 21	
			8.67	0.40	3.47	7.66	7.66	18.0		18.0	4.15	31.76	36	0.016	0.40	4.85	34.27	112.00	0.4	882.70	882.25		



STORM WATER MANAGEMENT

VOICE OF AMERICA PARK PHASE 1

PREPARED: 4-16-12

REVISED: 5-14-12

STORM WATER MANAGEMENT
VOICE OF AMERICA PARK, PHASE 1
Table of Contents

Summary.....	1 - 3
Pre-Developed Drainage Map.....	4
Post-Developed Drainage Map.....	5
Soils Map.....	6
Critical Storm Calculations.....	7 - 11
<u>Pre-Developed</u>	
Data (Area, CN, Time of Concentration, and Travel Time).....	12 - 16
Allowable Release Calculations.....	17 - 36
<u>Post-Developed:</u>	
Onsite Data (Area, CN, Time of Concentration, and Travel Time).....	37 - 41
Proposed Outlet Structure Details.....	42 - 56
Water Quality Calculations.....	57 - 61
Analysis Point #1 (Future Lake #1) Post-Developed Release Calculations	
1-Year Storm Event.....	62 - 65
5-Year Storm Event.....	66 - 67
10-Year Storm Event.....	68 - 69
25-Year Storm Event.....	70 - 71
50-Year Storm Event.....	72 - 73
100-Year Storm Event.....	74 - 75
Analysis Point #2 (Lakes #2 & 3) Post-Developed Release Calculations	
1-Year Storm Event.....	76 - 82
5-Year Storm Event.....	83 - 87
10-Year Storm Event.....	88 - 92
25-Year Storm Event.....	93 - 97
50-Year Storm Event.....	98 - 102
100-Year Storm Event.....	103 - 107

STORM WATER MANAGEMENT
VOICE OF AMERICA PARK, PHASE 1

Table of Contents

Analysis Point #3 (Lake #4) Post-Developed Release Calculations

1-Year Storm Event.....	108 - 111
5-Year Storm Event.....	112 - 113
10-Year Storm Event.....	114 - 117
25-Year Storm Event.....	118 - 119
50-Year Storm Event.....	120 - 121

Analysis Point #4 (Lake #5) Post-Developed Release Calculations

1-Year Storm Event.....	122 - 129
5-Year Storm Event.....	130 - 134
10-Year Storm Event.....	135 - 139
25-Year Storm Event.....	140 - 144
50-Year Storm Event.....	145 - 149
100-Year Storm Event.....	150 - 154

Emergency Spillway Calculations.....	155 - 156
---	------------------

SUMMARY OF DATA

Method of Hydrograph Development: TR-55

Software: Hydraflow



Design Criteria: The proposed lakes/basins will be sized using the critical storm method. The post-development storms of a frequency between the one-year and the critical storm will be controlled, so as to be equal or less than the pre-development peak runoff rate for a 24-hour, one-year frequency storm. For all storm events greater than the critical storm, reduce the flow rate by one storm event. In addition the lakes/basins will also include volume meeting the Ohio EPA water quality regulations.

Critical Storm:

Lake #1	10 Year
Lake #2 & 3	25 Year
Lake #4	25 Year
Lake #5	50 Year

Drainage Area Descriptions	Drainage Area	CN	Tc
	(Acres)		(Min)
Pre-Developed Area #1, Onsite tributary to analysis point #1	32.57	67.2	25.2
Pre-Developed Area #2, Onsite tributary to analysis point #2	83.62	60.4	37.1
Pre-Developed Area #3, Onsite tributary to analysis point #3	32.22	61.3	31.3
Pre-Developed Area #4, Onsite tributary to analysis point #4	39.81	61.4	26.4
Offsite Miami University VOA	10.40	90.2	10.0
Post-Developed Area #1, Onsite tributary Lake #1 and analysis point #1	24.30	77.8	20.5
Post-Developed Area #2, Onsite tributary to Lake #2, then Lake #3 and analysis point #2	17.60	68.6	18.0
Post-Developed Area #3, Onsite tributary to Lake #3 and analysis point #2	63.50	82.2	17.1
Post-Developed Area #4, Onsite tributary to Lake #4 and analysis point #3	22.25	78.3	18.7
Post-Developed Area #5, Onsite tributary to Lake #5 analysis point #3	67.30	74.8	22.3

Future Lake #1 T/Dike=888.60		Detention Basin Outlet: O.D.O.T. Type 2-4 Catch Basin, with 6" Wide Window @ 883.75 and (4) 4'-0" Wide Windows @887.00 Required Water Quality Volume = 9,924 CF, Achieved @884.62			
Frequency (yr)	Inflow (cfs)	Outflow (cfs)	Storage (ft ³) (ac-ft)		Elevation (ft)
1	16.03	0.80	33,933	0.78	885.16
5	37.65	1.90	77,512	1.78	885.67
10	47.96	2.52	98,242	2.26	885.91
25	63.32	3.48	129,637	2.98	886.27
50	77.13	4.41	158,393	3.64	886.59
100	93.46	5.58	192,721	4.42	886.97

Lake #1 Release Rates (Analysis Point #1)		
Storm Frequency (yr)	Pre-Developed Allowable Release Rate (cfs)	Post-Developed Release Rate (cfs)
1	5.58	0.80
5	5.58	1.90
10	5.58	2.52
25	33.39	3.48
50	48.59	4.41
100	62.80	5.58

Lake #2 T/Dike=891.00		Detention Basin Outlet: O.D.O.T. Type 2-3 Catch Basin, with 4" Wide Window @ 887.70 and (4) 3'-0" Wide Windows @888.90 Required Water Quality Volume = 6,820 CF, Achieved @887.80			
Frequency	Inflow	Outflow	Storage		Elevation
(yr)	(cfs)	(cfs)	(ft ³)	(ac-ft)	(ft)
1	4.61	0.17	14,762	0.34	888.01
5	17.22	0.45	41,397	0.95	888.29
10	23.78	0.62	54,891	1.26	888.43
25	33.83	0.91	75,293	1.73	888.64
50	43.17	1.21	94,034	2.16	888.84
100	54.70	2.46	108,504	2.49	888.99

Lake #2 Release Rates (Part of Analysis Point #2)		
Storm Frequency	Pre-Developed Allowable Release Rate	Post-Developed Release Rate
(yr)	(cfs)	(cfs)
1	(See Lake #3)	0.17
5	(See Lake #3)	0.45
10	(See Lake #3)	0.62
25	(See Lake #3)	0.91
50	(See Lake #3)	1.21
100	(See Lake #3)	2.46

Lake #3 T/Dike=886.50		Detention Basin Outlet: O.D.O.T. Type 2-3 Catch Basin, with 6 3/4" Orifice @ 881.75 and (4) 4'-0" Wide Windows @885.90 Required Water Quality Volume = 25,973 CF, Achieved @881.67			
Frequency	Inflow	Outflow	Storage		Elevation
(yr)	(cfs)	(cfs)	(ft ³)	(ac-ft)	(ft)
1	63.48	1.15	163,595	3.76	882.78
5	131.78	1.81	354,778	8.14	883.93
10	163.17	2.04	448,652	10.30	884.46
25	208.71	2.34	590,097	13.55	885.23
50	249.07	2.57	720,028	16.53	885.89
100	296.32	8.21	770,471	17.69	886.14

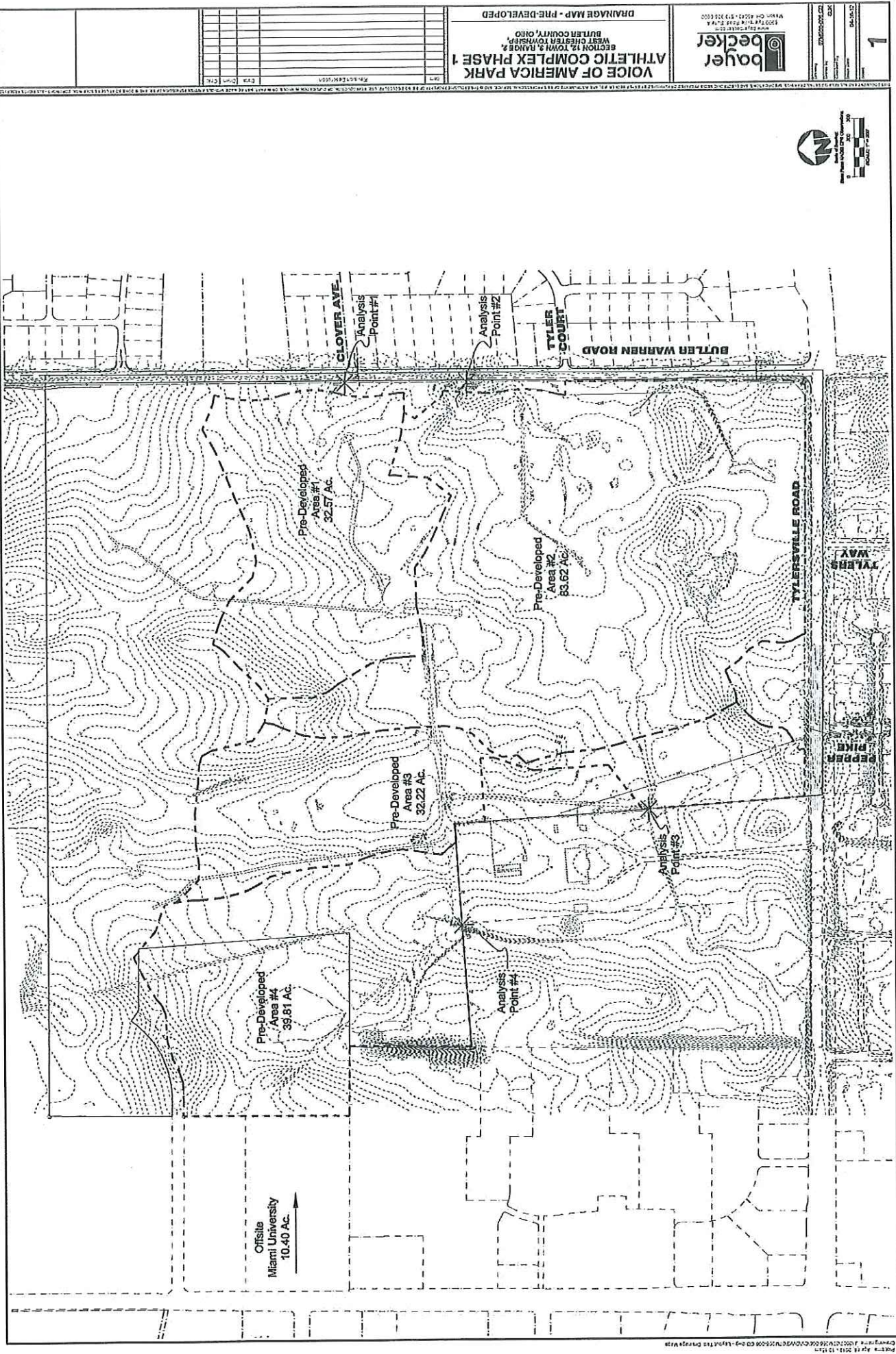
Lake #3 Release Rates (Analysis Point #2)		
Storm Frequency	Pre-Developed Allowable Release Rate	Post-Developed Release Rate
(yr)	(cfs)	(cfs)
1	2.62	1.15
5	2.62	1.81
10	2.62	2.04
25	2.62	2.34
50	2.62	2.57
100	85.37	8.21

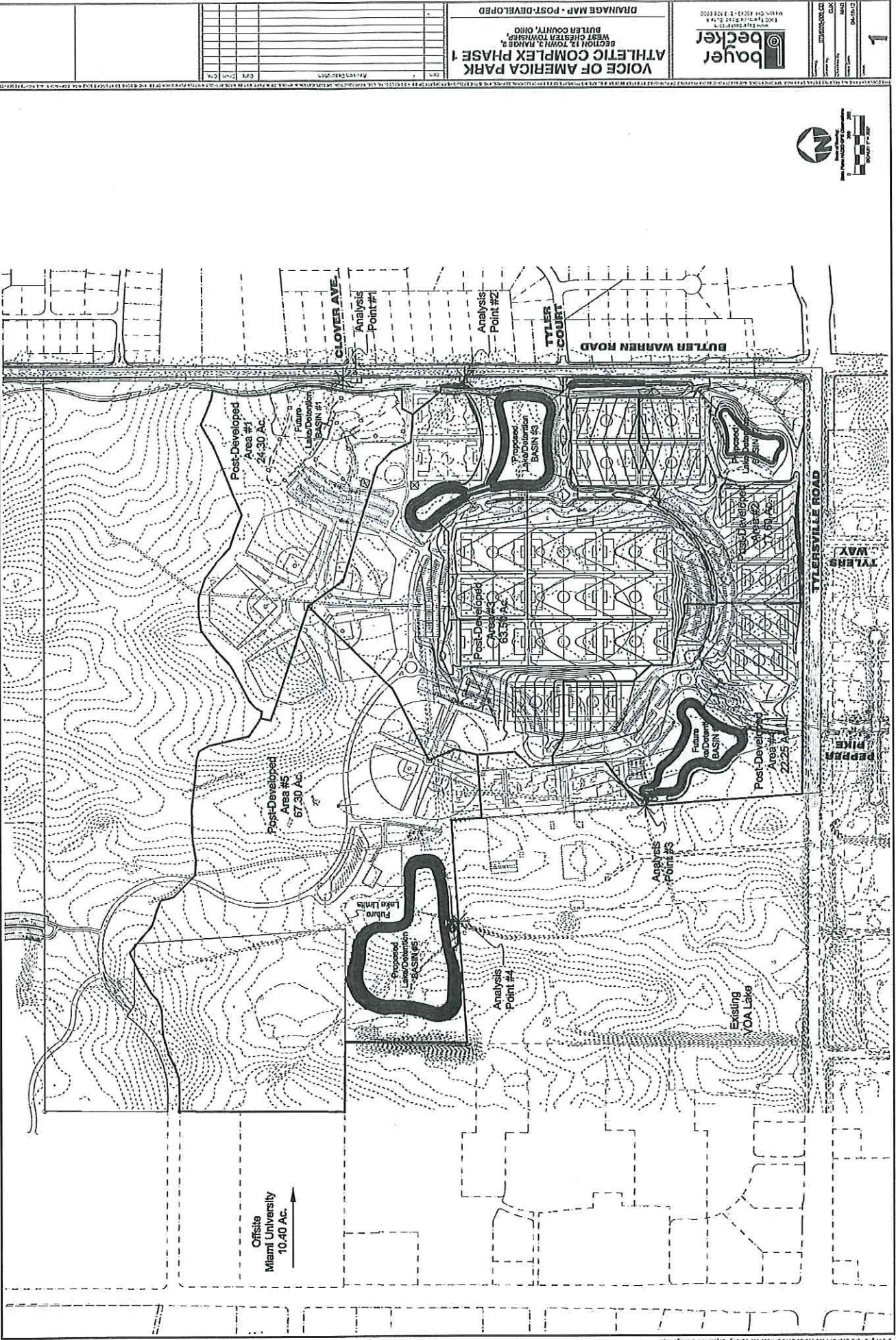
Lake #4 T/Dike=893.50		Detention Basin Outlet: Weir Wall, with 3" Wide Wier @ 889.50 and 6'-0" Wide Wier @892.00 Required Water Quality Volume = 8,984 CF, Achieved @889.59			
Frequency	Inflow	Outflow	Storage		Elevation
(yr)	(cfs)	(cfs)	(ft ³)	(ac-ft)	(ft)
1	16.74	0.29	44,851	1.03	890.03
5	38.45	0.73	92,728	2.13	890.48
10	48.83	0.98	115,258	2.65	890.69
25	64.13	1.38	148,286	3.40	891.00
50	77.85	1.85	177,215	4.07	891.26
100	94.05	3.61	199,116	4.57	891.45

Lake #4 Release Rates (Analysis Point #3)		
Storm Frequency	Pre-Developed Allowable Release Rate	Post-Developed Release Rate
(yr)	(cfs)	(cfs)
1	1.37	0.29
5	1.87	0.73
10	1.87	0.98
25	1.87	1.38
50	28.93	1.85
100	39.73	3.61

Lake #5 T/Dike=892.00		Detention Basin Outlet: Weir Wall, with 3" Wide Wier @ 887.50 and 10'-0" Wide Wier @891.00 Required Water Quality Volume = 27,484 CF, Achieved @887.58			
Frequency	Inflow	Outflow	Storage		Elevation
(yr)	(cfs)	(cfs)	(ft ³)	(ac-ft)	(ft)
1	37.00	0.36	173,230	3.98	888.11
5	93.90	0.99	369,967	8.49	888.70
10	127.27	1.35	462,524	10.62	888.98
25	172.21	1.93	598,925	13.75	889.37
50	210.21	4.55	670,655	15.40	889.58
100	255.41	9.07	734,539	16.86	889.77

Lake #5 Release Rates (Analysis Point #4)		
Storm Frequency	Pre-Developed Allowable Release Rate	Post-Developed Release Rate
(yr)	(cfs)	(cfs)
1	24.38	0.36
5	24.38	0.99
10	24.38	1.35
25	24.38	1.93
50	24.38	4.55
100	57.14	9.07







VOICE OF AMERICA PARK
ATHLETIC COMPLEX PHASE 1
 SECTION 15 TOWNSHIP 3 RANGE 2
 BUTLER COUNTY, OHIO
 DRAINAGE MAP - SOILS MAP

boyer
 & **beckner**
 ENGINEERS
 6201 N. 14th St., Suite 200
 Columbus, OH 43240-1100
 Phone: (614) 461-1100
 Fax: (614) 461-1101
 Email: info@boyerbeckner.com

Runoff curve number and runoff (TR-55)

Project: VOA Park
Analysis Point #1

By: GJK
Checked: _____

Date: 2/4/2012
Date: _____
Job #: 07M056.006

On-site Pre-Developed

Drainage Area: 32.57 Ac
Curve Number: 67.2
Year storm: 1
Intensity: 2.33
S= 4.88
Q= 0.29 in
V= 34,755 ft³
0.80 Ac-ft

$$S=(1000/CN)-10$$

$$Q=(P-0.2S)^2/(P+0.8S)$$

$$V=(Q/12*43560*A)$$

On-site Post-Developed (Area 1)

Drainage Area: 24.30 Ac
Curve Number: 77.8
Year storm: 1
Intensity: 2.33
S= 2.85
Q= 0.67 in
V= 59,188 ft³
1.36 Ac-ft

$$S=(1000/CN)-10$$

$$Q=(P-0.2S)^2/(P+0.8S)$$

$$V=(Q/12*43560*A)$$

	CN	Yr Storm	S	Q (in)	V (ft ³)
Onsite Pre-developed	67.2	1	4.9	0.3	34755
Onsite Post-developed	77.8	1	2.9	0.7	59188

$$((V_{\text{post}}/V_{\text{pre}})-1)*100\% = \text{Runoff_Increase} \quad 70\%$$

Between %'s		Storm Frequency
-	10	1
10.0	20	2
20.0	50	5
50.0	100	10
100.0	250	25
250.0	500	50
500.0	-	100

Critical Storm: 10 yr

Project: Voice of America Park

Drainage Area Description:

Critical Storm Calculation - Areas 2 and 3 combined, Onsite tributary to analysis point #2

Job #: 07M056.006

Initials: GJK

Date: 4/4/2012

Drainage Area: 81.10 Acres

Soil Types: 45 % Type B
55 % Type C

Land Use: Open Space 57 %
Lake 6 %
Impervious 15 %
Synthetic Turf Fields 22 % (9 Fields Total)

Composite Runoff Curve Number:

Ground Cover	Soil Type	CN	Soil Type %	Land Use %	
Open Space	B	61	45	57	15.71
Lake	B	100	45	6	2.71
Impervious	B	98	45	15	6.64
Synthetic Turf Fields	B	90	45	22	8.92
Open Space	C	74	55	57	23.12
Lake	C	100	55	6	3.29
Impervious	C	98	55	15	8.06
Synthetic Turf Fields	C	90	55	22	10.81

Composite CN = 79.3

Runoff curve number and runoff (TR-55)

Project: VOA Park
Analysis Point #2

By: GJK
 Checked: _____

Date: 2/4/2012
 Date: _____
 Job #: 07M056.006

On-site Pre-Developed

Drainage Area: 83.6 Ac

Curve Number: 60.4

Year storm: 1

Intensity: 2.33

$S = (1000/CN) - 10$ S= 6.56

$Q = (P - 0.2S)^2 / (P + 0.8S)$ Q= 0.14 in

$V = (Q/12 * 43560 * A)$ V= 41,587 ft³
 0.95 Ac-ft

On-site Post-Developed (Areas 2 + 6)

Drainage Area: 81.1 Ac

Curve Number: 79.3

Year storm: 1

Intensity: 2.33

$S = (1000/CN) - 10$ S= 2.62

$Q = (P - 0.2S)^2 / (P + 0.8S)$ Q= 0.74 in

$V = (Q/12 * 43560 * A)$ V= 217,269 ft³
 4.99 Ac-ft

	CN	Yr Storm	S	Q (in)	V (ft ³)
Onsite Pre-developed	60.4	1	6.6	0.1	41587
Onsite Post-developed	79.3	1	2.6	0.7	217269

$$((V_{\text{post}}/V_{\text{pre}}) - 1) * 100\% = \text{Runoff_Increase} \quad 422\%$$

Between %'s		Storm Frequency
-	10	1
10.0	20	2
20.0	50	5
50.0	100	10
100.0	250	25
250.0	500	50
500.0	-	100

Critical Storm: 50 yr

Runoff curve number and runoff (TR-55)

Project: VOA Park
Analysis Point #3

By: GJK
Checked: _____

Date: 2/4/2012
Date: _____
Job #: 07M056.006

On-site Pre-Developed

Drainage Area: 32.2 Ac

Curve Number: 61.3

Year storm: 1

Intensity: 2.33

$$S = (1000/CN) - 10$$

$$S = 6.31$$

$$Q = (P - 0.2S)^2 / (P + 0.8S)$$

$$Q = 0.15 \text{ in}$$

$$V = (Q/12 * 43560 * A)$$

$$V = 18,054 \text{ ft}^3 \\ 0.41 \text{ Ac-ft}$$

On-site Post-Developed (Area 3)

Drainage Area: 22.0 Ac

Curve Number: 78.3

Year storm: 1

Intensity: 2.33

$$S = (1000/CN) - 10$$

$$S = 2.77$$

$$Q = (P - 0.2S)^2 / (P + 0.8S)$$

$$Q = 0.69 \text{ in}$$

$$V = (Q/12 * 43560 * A)$$

$$V = 55,379 \text{ ft}^3 \\ 1.27 \text{ Ac-ft}$$

	CN	Yr Storm	S	Q (in)	V (ft ³)
Onsite Pre-developed	61.3	1	6.3	0.2	18054
Onsite Post-developed	78.3	1	2.8	0.7	55379

$$((V_{\text{post}}/V_{\text{pre}}) - 1) * 100\% = \text{Runoff_Increase} \quad 207\%$$

Between %'s		Storm Frequency
-	10	1
10.0	20	2
20.0	50	5
50.0	100	10
100.0	250	25
250.0	500	50
500.0	-	100

Critical Storm: 25 yr

Runoff curve number and runoff (TR-55)

Project: VOA Park
Analysis Point #4

By: GJK
Checked: _____

Date: 2/4/2012
Date: _____
Job #: 07M056.006

On-site Pre-Developed

Drainage Area: 39.8 Ac

Curve Number: 61.4

Year storm: 1

Intensity: 2.33

$$S = (1000/CN) - 10$$

$$S = 6.29$$

$$Q = (P - 0.2S)^2 / (P + 0.8S)$$

$$Q = 0.16 \text{ in}$$

$$V = (Q/12 * 43560 * A)$$

$$V = 22,594 \text{ ft}^3 \\ 0.52 \text{ Ac-ft}$$

On-site Post-Developed (Area 4)

Drainage Area: 67.3 Ac

Curve Number: 74.8

Year storm: 1

Intensity: 2.33

$$S = (1000/CN) - 10$$

$$S = 3.37$$

$$Q = (P - 0.2S)^2 / (P + 0.8S)$$

$$Q = 0.55 \text{ in}$$

$$V = (Q/12 * 43560 * A)$$

$$V = 133,351 \text{ ft}^3 \\ 3.06 \text{ Ac-ft}$$

	CN	Yr Storm	S	Q (in)	V (ft ³)
Onsite Pre-developed	61.4	1	6.3	0.2	22594
Onsite Post-developed	74.8	1	3.4	0.5	133351

$$((V_{\text{post}}/V_{\text{pre}}) - 1) * 100\% = \text{Runoff_Increase} \quad 490 \%$$

Between %'s		Storm Frequency
-	10	1
10.0	20	2
20.0	50	5
50.0	100	10
100.0	250	25
250.0	500	50
500.0	-	100

Critical Storm:	50 yr
------------------------	--------------

Project: Voice of America Park

Drainage Area Description:

Pre-Developed Area #1, Onsite tributary to analysis point #1

Job #: 07M056.006

Initials: GJK

Date: 4/4/2012

Drainage Area: 32.57 Acres

Soil Types: 20 % Type B
80 % Type C

Land Use: Meadow 75 %
Brush (Good) 23 %
Gravel 2 %

Composite Runoff Curve Number:

Ground Cover	Soil Type	CN	Soil Type %	Land Use %	
Meadow	B	58	20	75	8.70
Brush (Good)	B	48	20	23	2.21
Gravel	B	85	20	2	0.34
Meadow	C	71	80	75	42.60
Brush (Good)	C	65	80	23	11.96
Gravel	C	89	80	2	1.42

Composite CN = 67.2

Time of Concentration:

Sheet Flow:

Length = 100

Slope(ft/ft) = 0.0200

Manning's, n = 0.17

Tc

0.19 hr

Shallow Concentrated Flow:

Length = 600

Slope(ft/ft) = 0.0120

Velocity (fps) = 1.8

0.09 hr

Channel Flow:

Length = 1225

Velocity (fps) = 2.5

0.14 hr

Tc = 0.42 hr
25.2 min

Project: Voice of America Park

Drainage Area Description:

Pre-Developed Area #2, Onsite tributary to analysis point #2

Job #: 07M056.006

Initials: GJK

Date: 4/4/2012

Drainage Area: 83.62 Acres

Soil Types: 50 % Type B
50 % Type C

Land Use: Meadow 45 %
Brush (Good) 54 %
Gravel 1 %

Composite Runoff Curve Number:

Ground Cover	Soil Type	CN	Soil Type %	Land Use %	
Meadow	B	58	50	45	13.05
Brush (Good)	B	48	50	54	12.96
Gravel	B	85	50	1	0.43
Meadow	C	71	50	45	15.98
Brush (Good)	C	65	50	54	17.55
Gravel	C	89	50	1	0.45

Composite CN = 60.4

Time of Concentration:

Sheet Flow:

Length = 100

Slope(ft/ft) = 0.0200

Manning's, n = 0.17

Tc

0.19 hr

Shallow Concentrated Flow:

Length = 820

Slope(ft/ft) = 0.0120

Velocity (fps) = 1.8

0.13 hr

Channel Flow:

Length = 2710

Velocity (fps) = 2.5

0.30 hr

Tc =

0.62 hr

37.1 min

Project: Voice of America Park

Drainage Area Description:

Pre-Developed Area #3, Onsite tributary to analysis point #3

Job #: 07M056.006

Initials: GJK

Date: 4/4/2012

Drainage Area: 32.22 Acres

Soil Types: 35 % Type B
65 % Type C

Land Use: Meadow 23 %
Brush (Good) 75 %
Gravel 2 %

Composite Runoff Curve Number:

Ground Cover	Soil Type	CN	Soil Type %	Land Use %	
Meadow	B	58	35	23	4.67
Brush (Good)	B	48	35	75	12.60
Gravel	B	85	35	2	0.60
Meadow	C	71	65	23	10.61
Brush (Good)	C	65	65	75	31.69
Gravel	C	89	65	2	1.16

Composite CN = 61.3

Time of Concentration:

Sheet Flow:

Length = 100

Slope(ft/ft) = 0.0150

Manning's, n = 0.17

T_c

0.21 hr

Shallow Concentrated Flow:

Length = 570

Slope(ft/ft) = 0.0120

Velocity (fps) = 1.8

0.09 hr

Channel Flow:

Length = 1980

Velocity (fps) = 2.5

0.22 hr

T_c = 0.52 hr

31.3 min

Project: Voice of America Park

Drainage Area Description:

Pre-Developed Area #4, Onsite tributary to analysis point #4

Job #: 07M056.006

Initials: GJK

Date: 4/4/2012

Drainage Area: 39.81 Acres

Soil Types: 45 % Type B
55 % Type C

Land Use: Meadow 44 %
Brush (Good) 54 %
Gravel 2 %

Composite Runoff Curve Number:

Ground Cover	Soil Type	CN	Soil Type %	Land Use %	
Meadow	B	58	45	44	11.48
Brush (Good)	B	48	45	54	11.66
Gravel	B	85	45	2	0.77
Meadow	C	71	55	44	17.18
Brush (Good)	C	65	55	54	19.31
Gravel	C	89	55	2	0.98

Composite CN = 61.4

Time of Concentration:

Sheet Flow:

Length = 100

Slope(ft/ft) = 0.0150

Manning's, n = 0.17

Tc

0.21 hr

Shallow Concentrated Flow:

Length = 950

Slope(ft/ft) = 0.0120

Velocity (fps) = 1.8

0.15 hr

Channel Flow:

Length = 720

Velocity (fps) = 2.5

0.08 hr

Tc =

0.44 hr

26.4 min

Project: Voice of America Park

Drainage Area Description:

Offsite Miami University VOA

Job #: 07M056.006

Initials: GJK

Date: 4/4/2012

Drainage Area: 10.4 Acres

Soil Types: 15 % Type B
85 % Type C

Land Use: Open Space 30 %
Impervious 70 %

Composite Runoff Curve Number:

Ground Cover	Soil Type	CN	Soil Type %	Land Use %	
Open Space	B	61	15	30	2.75
Impervious	B	98	15	70	10.29
Open Space	C	74	85	30	18.87
Impervious	C	98	85	70	58.31

Composite CN = 90.2

Time of Concentration:

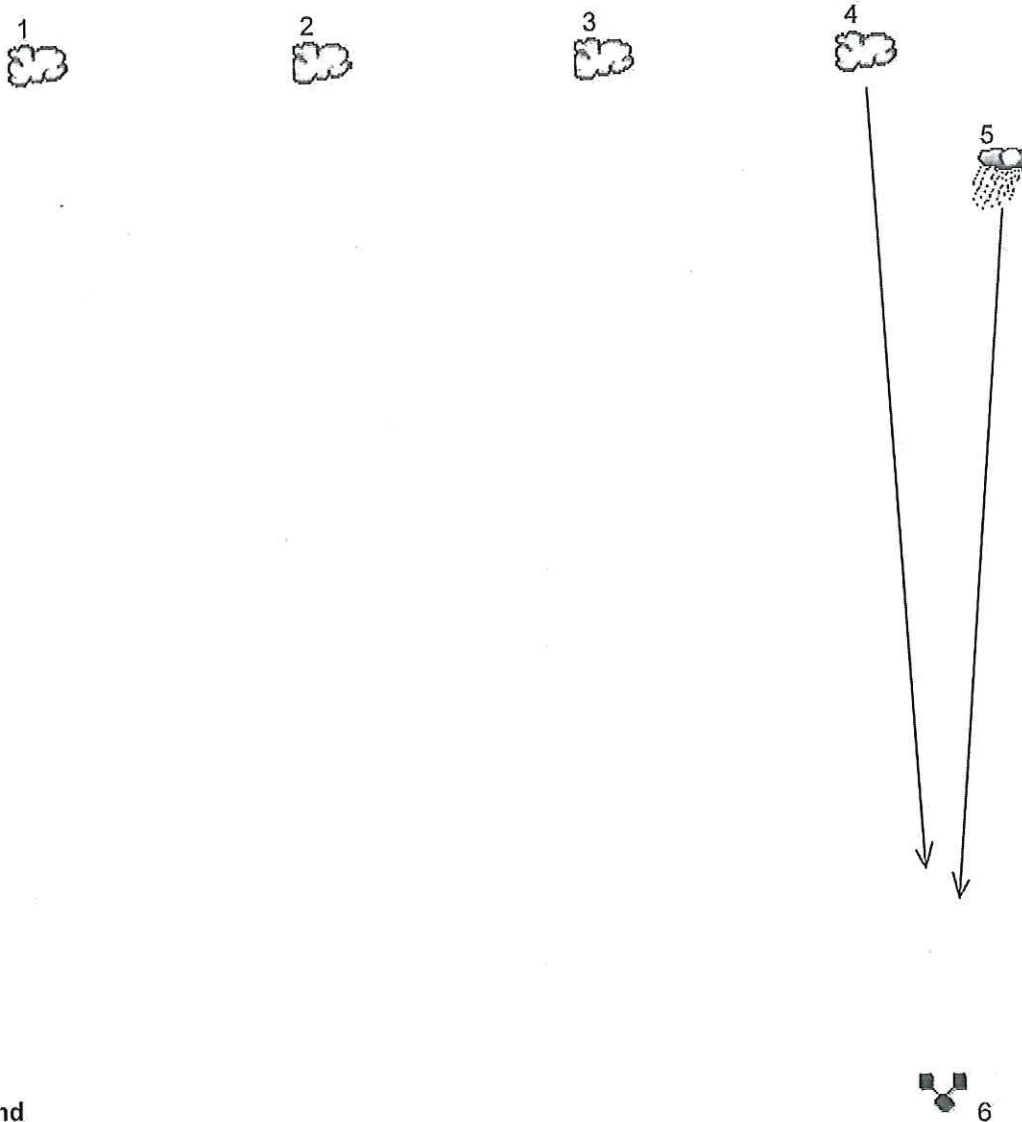
Tc = 0.17 hr
10.0 min

Notes:

Drainage area and time of concentration are from calculations by Abercrombie and Associates, Inc. dated May 16, 2007 and received by fax on February 5, 2009.

Watershed Model Schematic

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2011 by Autodesk, Inc. v8



Legend

Hyd.	Origin	Description
1	SCS Runoff	Pre-Developed Area #1 - Analysis Point #1
2	SCS Runoff	Pre-Developed Area #2 - Analysis Point #2
3	SCS Runoff	Pre-Developed Area #3 - Analysis Point #3
4	SCS Runoff	Pre-Developed Area #4 - Analysis Point #4
5	Manual	Offsite Miami University 50yr
6	Combine	Analysis Point #4 Allowable

Hydrograph Return Period Recap

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2011 by Autodesk, Inc. v8

Hyd. No.	Hydrograph type (origin)	Inflow hyd(s)	Peak Outflow (cfs)								Hydrograph Description
			1-yr	2-yr	3-yr	5-yr	10-yr	25-yr	50-yr	100-yr	
1	SCS Runoff	-----	5.576	-----	-----	-----	33.39	48.59	62.80	80.12	Pre-Developed Area #1 - Analysis Poi
2	SCS Runoff	-----	2.622	-----	-----	-----	37.24	61.30	85.37	115.56	Pre-Developed Area #2 - Analysis Poi
3	SCS Runoff	-----	1.366	-----	-----	-----	17.86	28.93	39.73	53.21	Pre-Developed Area #3 - Analysis Poi
4	SCS Runoff	-----	1.868	-----	-----	-----	26.01	41.88	57.14	76.13	Pre-Developed Area #4 - Analysis Poi
5	Manual	-----	22.70	-----	-----	-----	0.000	0.000	0.000	0.000	Offsite Miami University 50yr
6	Combine	4, 5	24.38	-----	-----	-----	26.01	41.88	57.14	76.13	Analysis Point #4 Allowable
Proj. file: Allowable.gpw										Monday, Apr 16, 2012	

Hydrograph Report

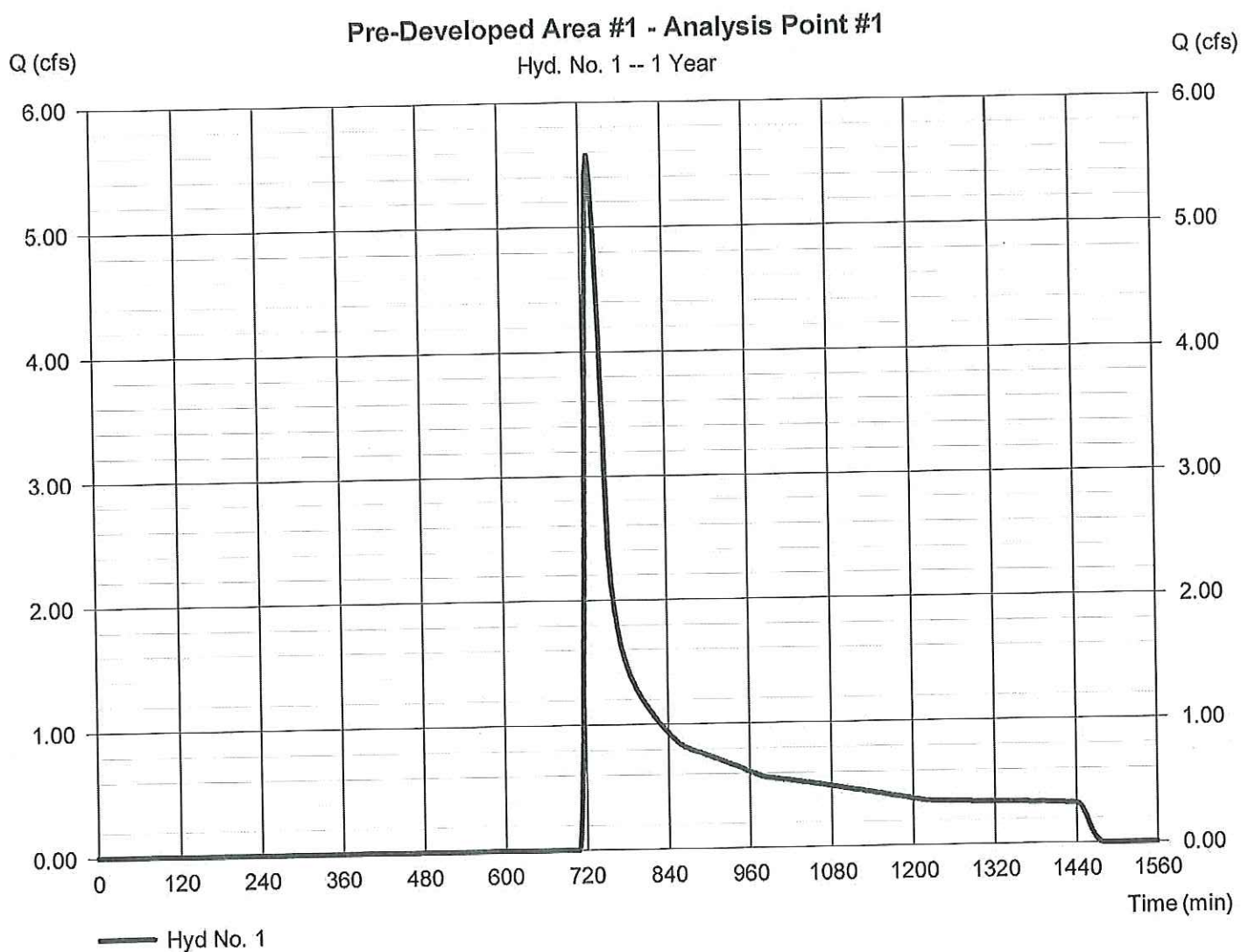
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2011 by Autodesk, Inc. v8

Monday, Apr 16, 2012

Hyd. No. 1

Pre-Developed Area #1 - Analysis Point #1

Hydrograph type	= SCS Runoff	Peak discharge	= 5.576 cfs
Storm frequency	= 1 yrs	Time to peak	= 732 min
Time interval	= 2 min	Hyd. volume	= 34,194 cuft
Drainage area	= 32.570 ac	Curve number	= 67.2
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 25.20 min
Total precip.	= 2.33 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



Hydrograph Report

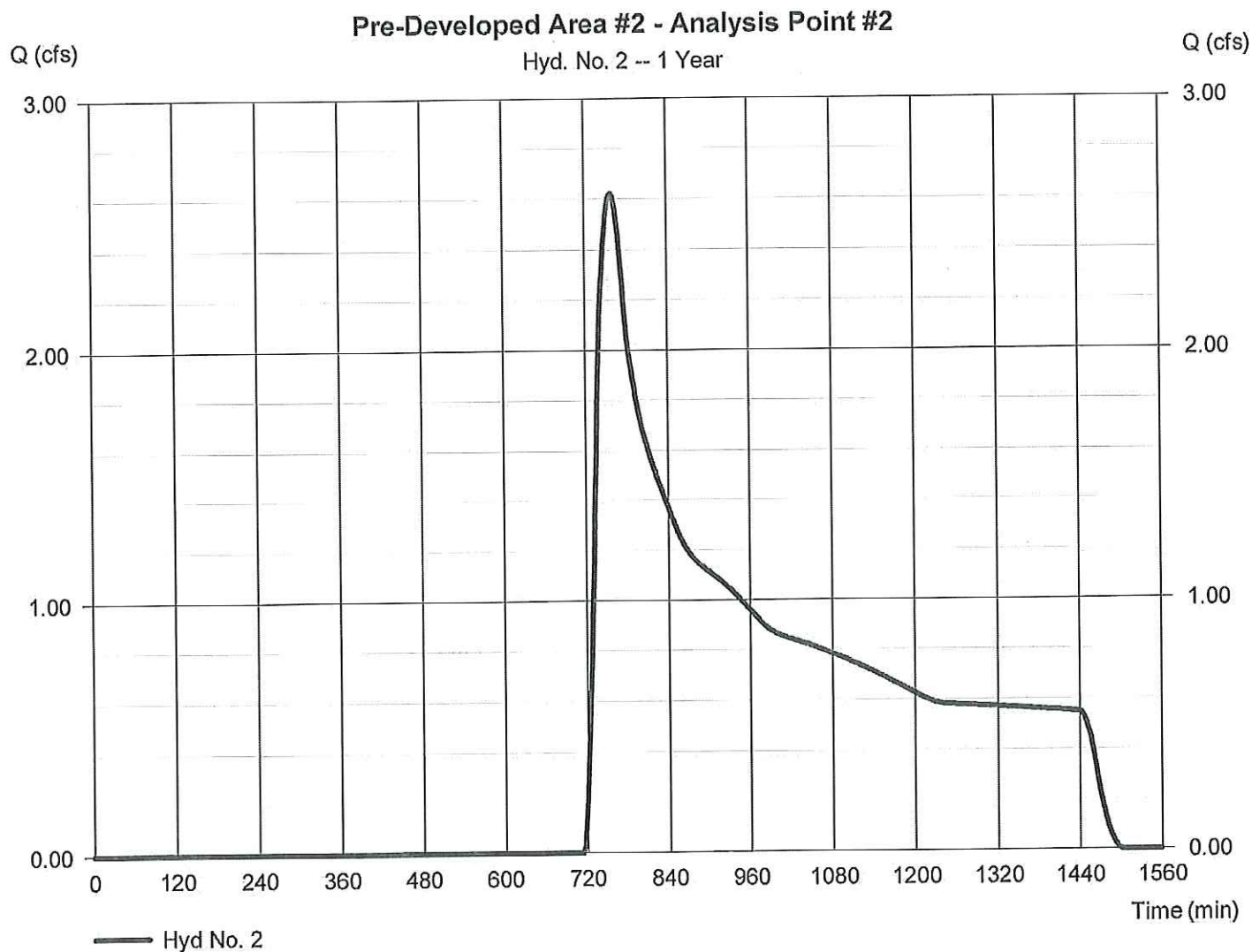
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2011 by Autodesk, Inc. v8

Monday, Apr 16, 2012

Hyd. No. 2

Pre-Developed Area #2 - Analysis Point #2

Hydrograph type	= SCS Runoff	Peak discharge	= 2.622 cfs
Storm frequency	= 1 yrs	Time to peak	= 760 min
Time interval	= 2 min	Hyd. volume	= 41,581 cuft
Drainage area	= 83.620 ac	Curve number	= 60.4
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 37.10 min
Total precip.	= 2.33 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



Hydrograph Report

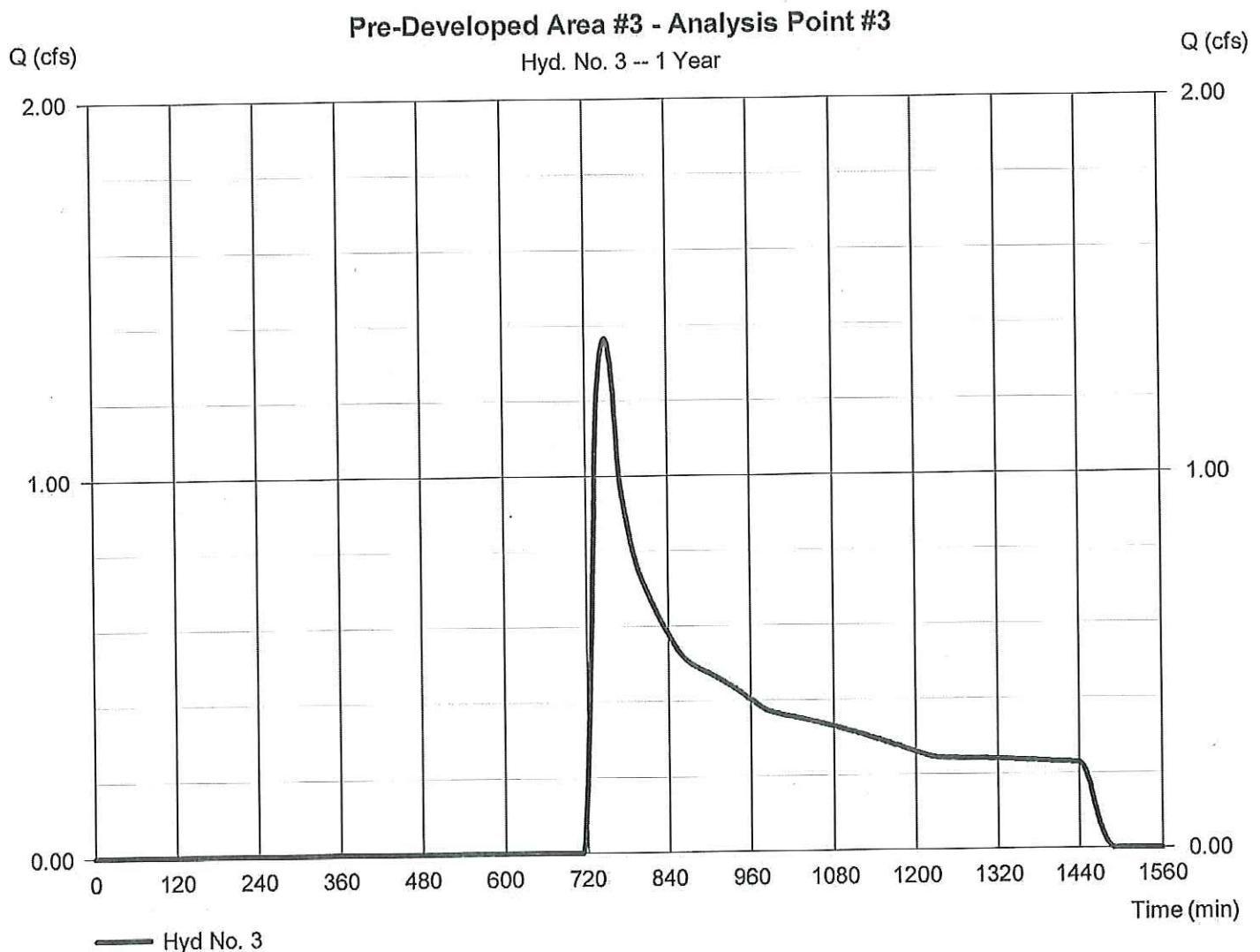
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2011 by Autodesk, Inc. v8

Monday, Apr 16, 2012

Hyd. No. 3

Pre-Developed Area #3 - Analysis Point #3

Hydrograph type	= SCS Runoff	Peak discharge	= 1.366 cfs
Storm frequency	= 1 yrs	Time to peak	= 750 min
Time interval	= 2 min	Hyd. volume	= 18,211 cuft
Drainage area	= 32.220 ac	Curve number	= 61.3
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 31.30 min
Total precip.	= 2.33 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



Hydrograph Report

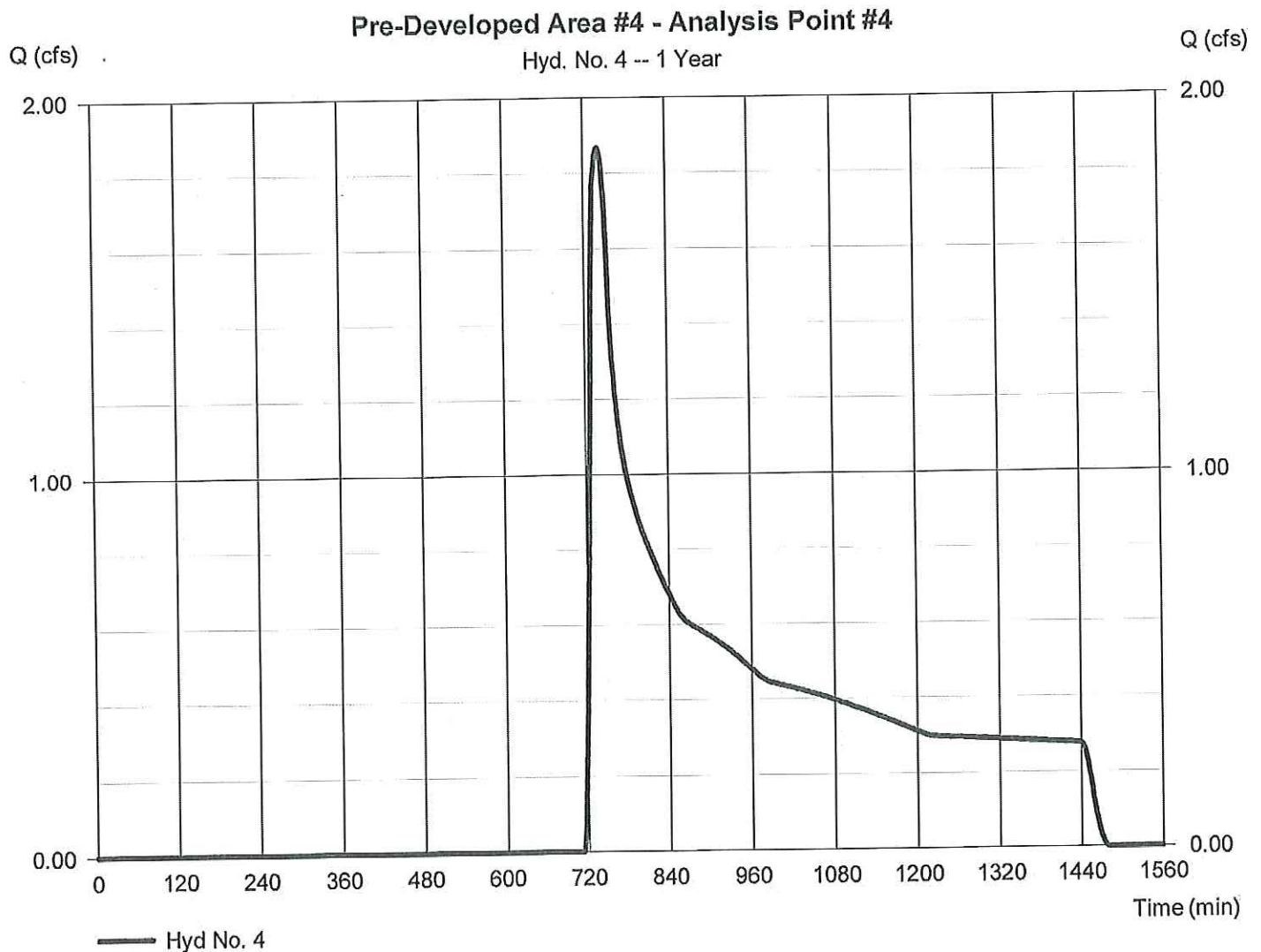
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2011 by Autodesk, Inc. v8

Monday, Apr 16, 2012

Hyd. No. 4

Pre-Developed Area #4 - Analysis Point #4

Hydrograph type	= SCS Runoff	Peak discharge	= 1.868 cfs
Storm frequency	= 1 yrs	Time to peak	= 742 min
Time interval	= 2 min	Hyd. volume	= 22,165 cuft
Drainage area	= 39.810 ac	Curve number	= 61.4
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 26.40 min
Total precip.	= 2.33 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2011 by Autodesk, Inc. v8

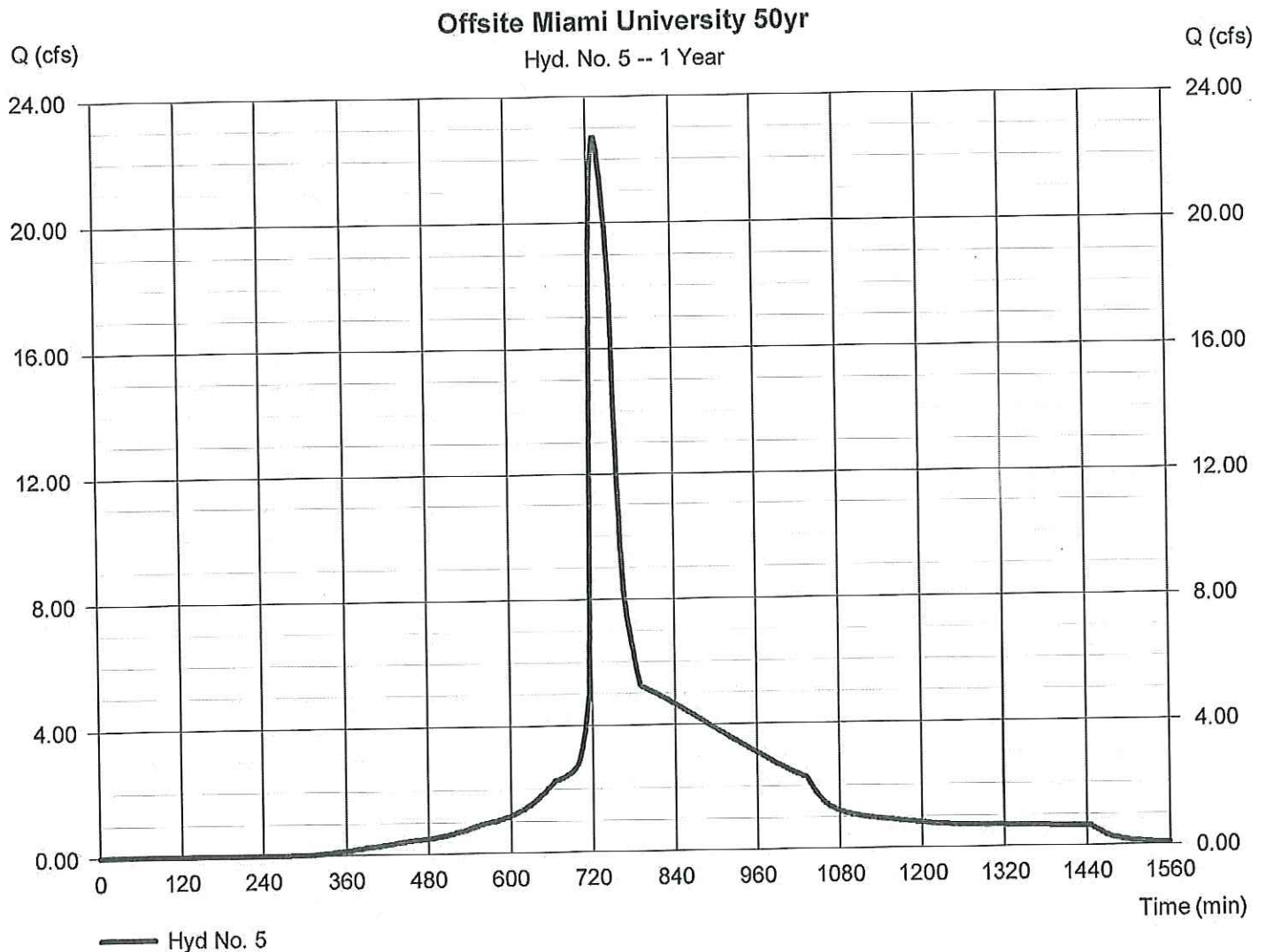
Monday, Apr 16, 2012

Hyd. No. 5

Offsite Miami University 50yr

Hydrograph type = Manual
Storm frequency = 1 yrs
Time interval = 2 min

Peak discharge = 22.70 cfs
Time to peak = 732 min
Hyd. volume = 163,737 cuft



Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2011 by Autodesk, Inc. v8

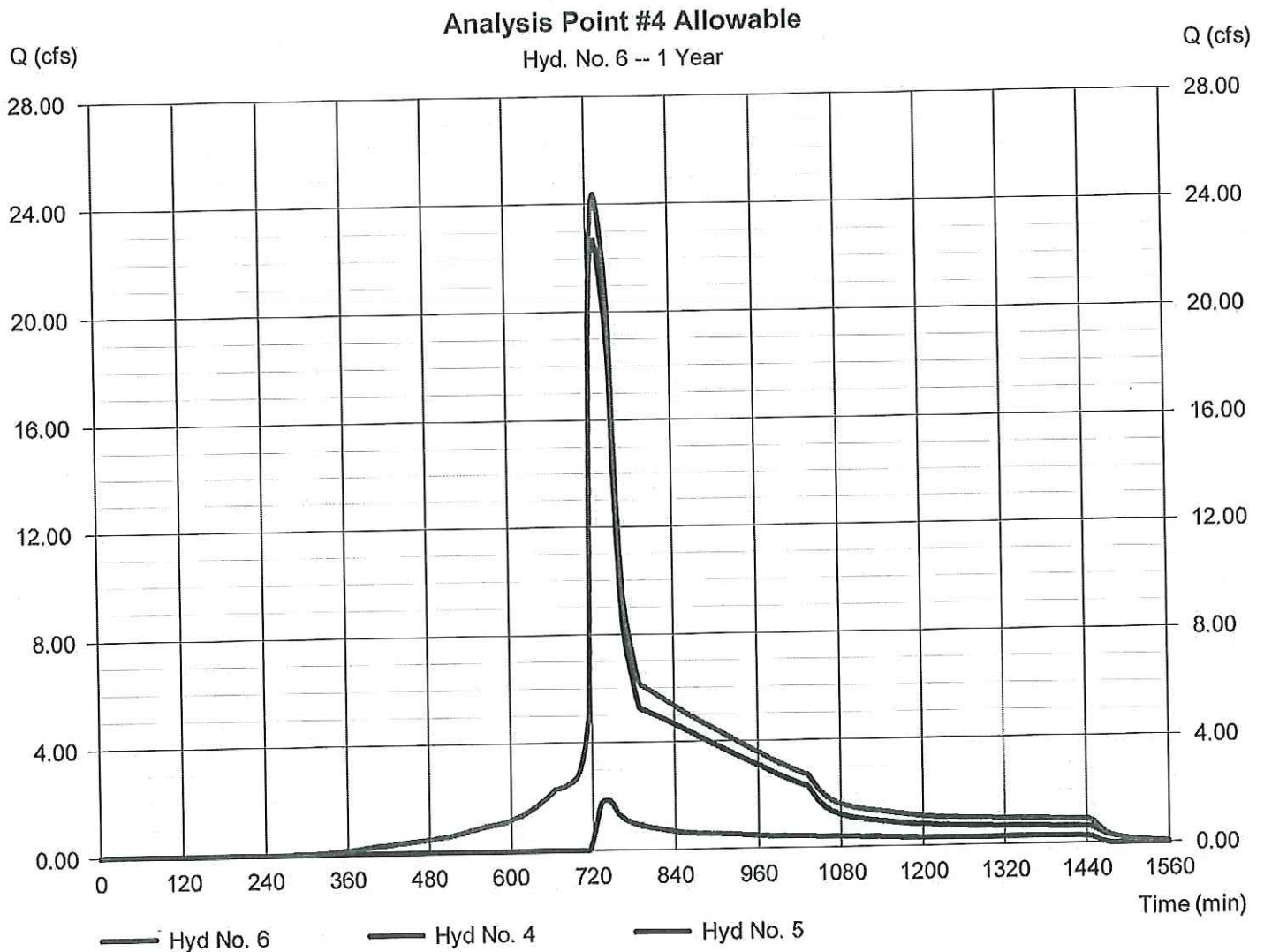
Monday, Apr 16, 2012

Hyd. No. 6

Analysis Point #4 Allowable

Hydrograph type = Combine
Storm frequency = 1 yrs
Time interval = 2 min
Inflow hyds. = 4, 5

Peak discharge = 24.38 cfs
Time to peak = 732 min
Hyd. volume = 185,901 cuft
Contrib. drain. area = 39.810 ac



Hydrograph Report

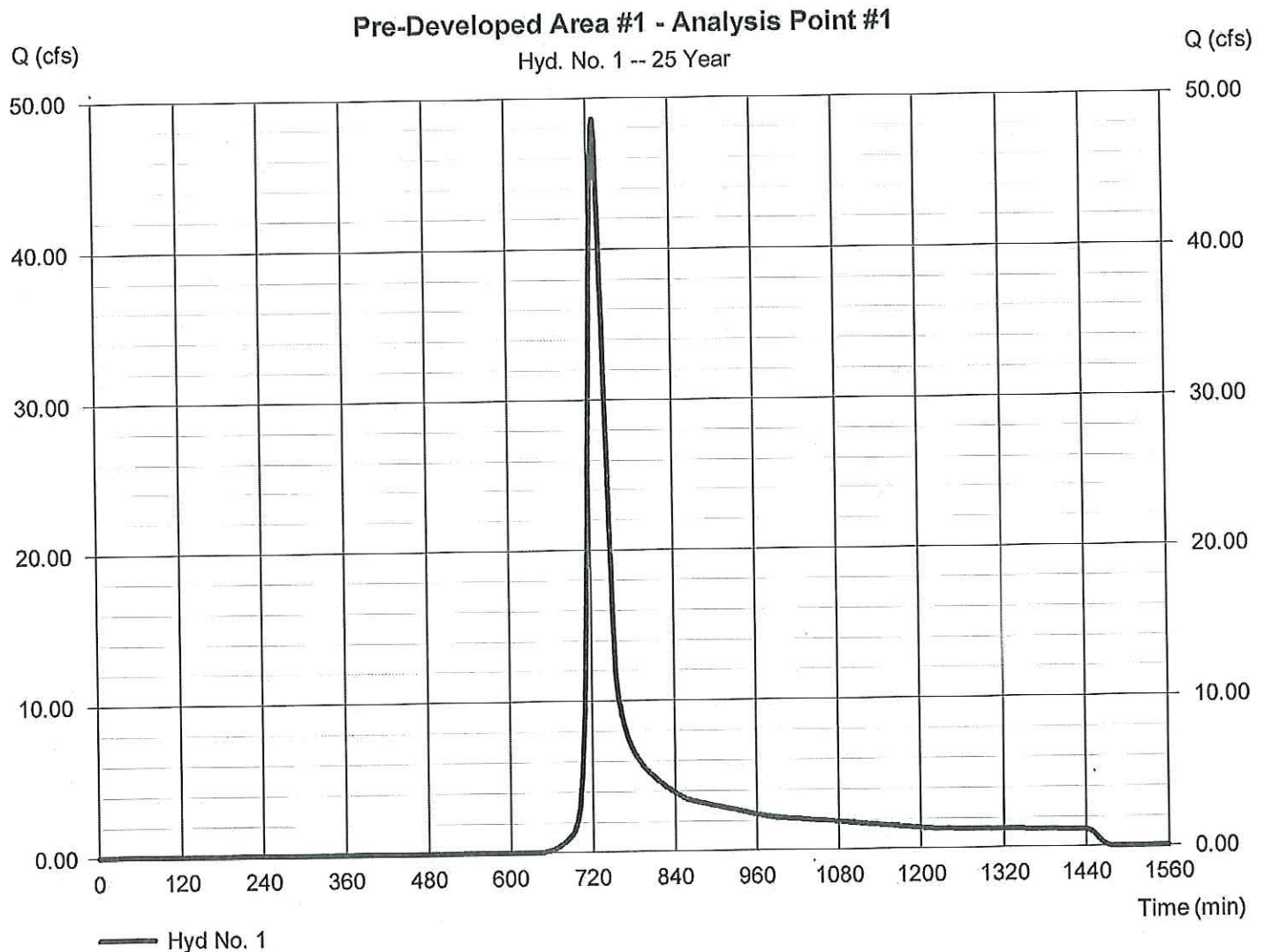
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2011 by Autodesk, Inc. v8

Monday, Apr 16, 2012

Hyd. No. 1

Pre-Developed Area #1 - Analysis Point #1

Hydrograph type	= SCS Runoff	Peak discharge	= 48.59 cfs
Storm frequency	= 25 yrs	Time to peak	= 730 min
Time interval	= 2 min	Hyd. volume	= 187,552 cuft
Drainage area	= 32.570 ac	Curve number	= 67.2
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 25.20 min
Total precip.	= 4.70 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



Hydrograph Report

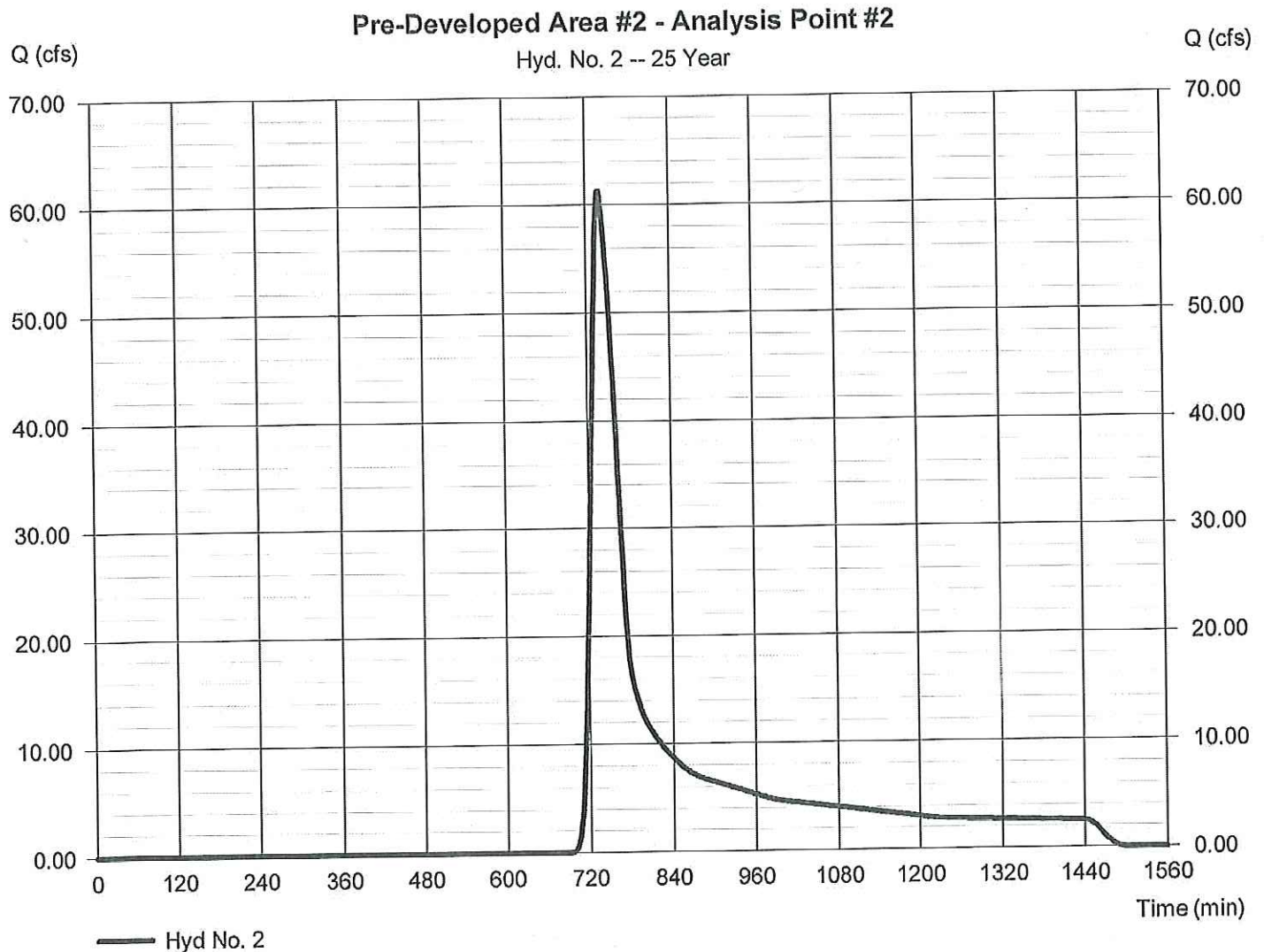
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2011 by Autodesk, Inc. v8

Monday, Apr 16, 2012

Hyd. No. 2

Pre-Developed Area #2 - Analysis Point #2

Hydrograph type	= SCS Runoff	Peak discharge	= 61.30 cfs
Storm frequency	= 25 yrs	Time to peak	= 738 min
Time interval	= 2 min	Hyd. volume	= 350,500 cuft
Drainage area	= 83.620 ac	Curve number	= 60.4
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 37.10 min
Total precip.	= 4.70 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



Hydrograph Report

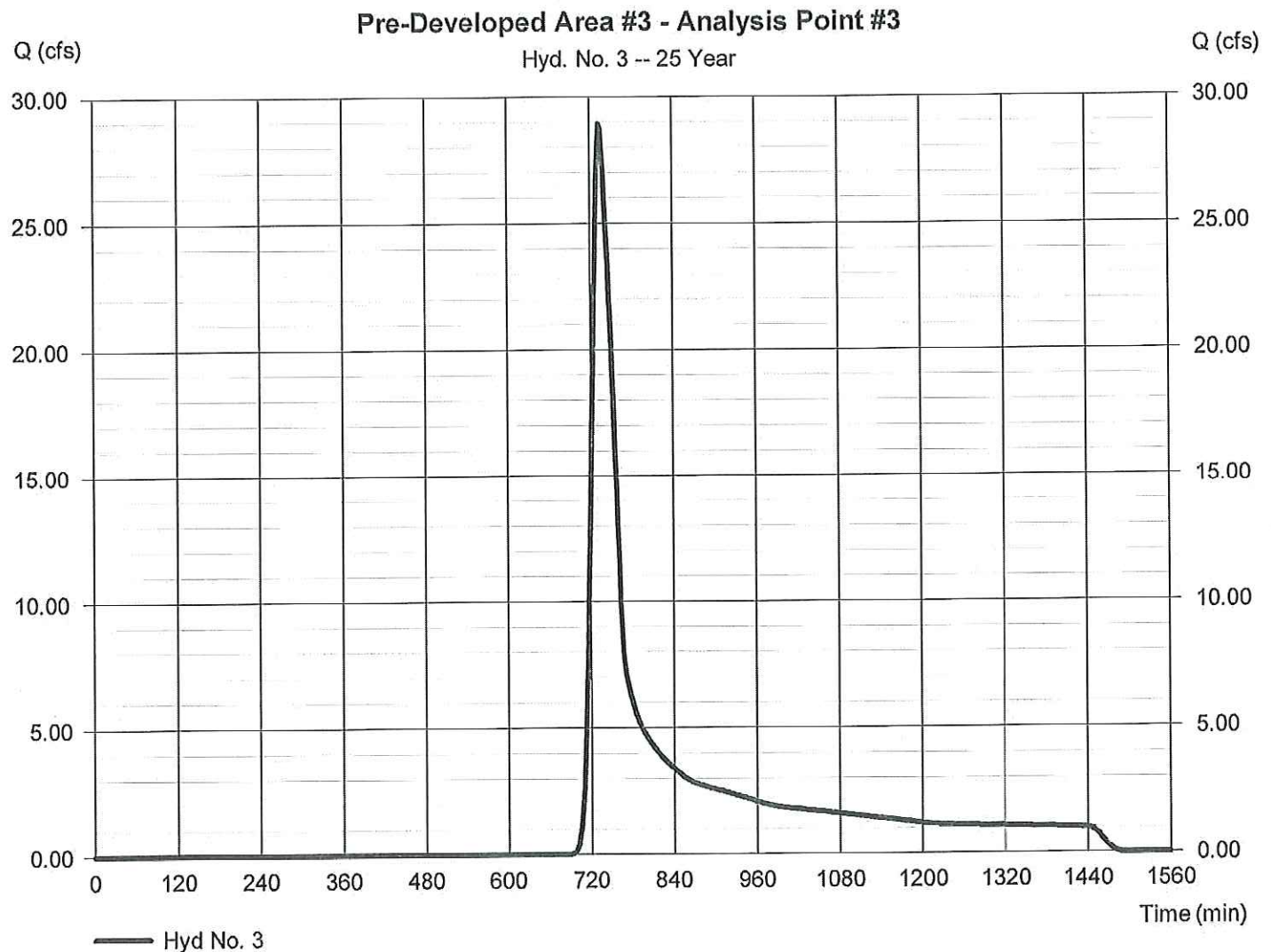
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2011 by Autodesk, Inc. v8

Monday, Apr 16, 2012

Hyd. No. 3

Pre-Developed Area #3 - Analysis Point #3

Hydrograph type	= SCS Runoff	Peak discharge	= 28.93 cfs
Storm frequency	= 25 yrs	Time to peak	= 734 min
Time interval	= 2 min	Hyd. volume	= 143,498 cuft
Drainage area	= 32.220 ac	Curve number	= 61.3
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 31.30 min
Total precip.	= 4.70 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2011 by Autodesk, Inc. v8

Monday, Apr 16, 2012

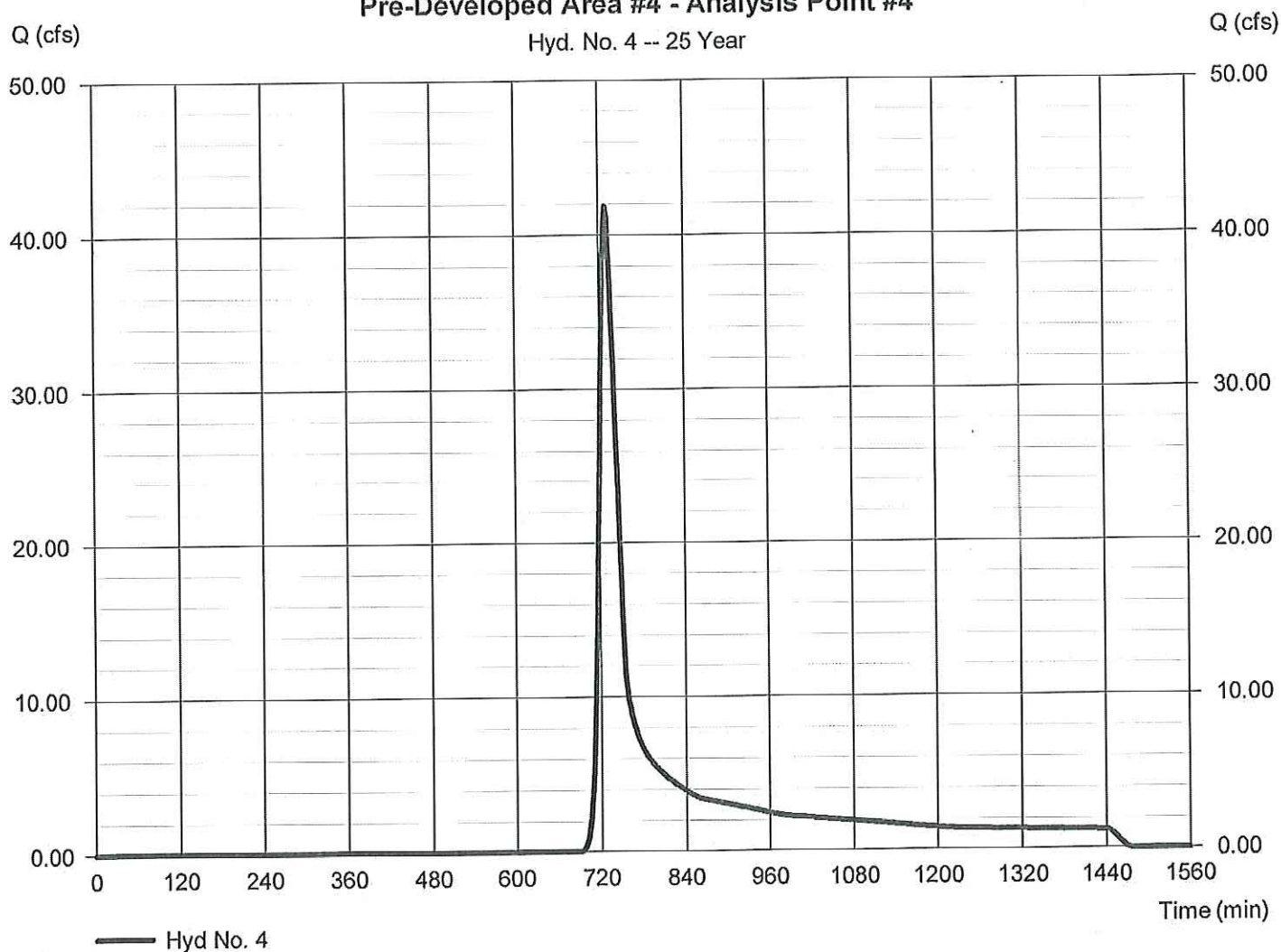
Hyd. No. 4

Pre-Developed Area #4 - Analysis Point #4

Hydrograph type	= SCS Runoff	Peak discharge	= 41.88 cfs
Storm frequency	= 25 yrs	Time to peak	= 730 min
Time interval	= 2 min	Hyd. volume	= 173,288 cuft
Drainage area	= 39.810 ac	Curve number	= 61.4
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 26.40 min
Total precip.	= 4.70 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

Pre-Developed Area #4 - Analysis Point #4

Hyd. No. 4 -- 25 Year



Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2011 by Autodesk, Inc. v8

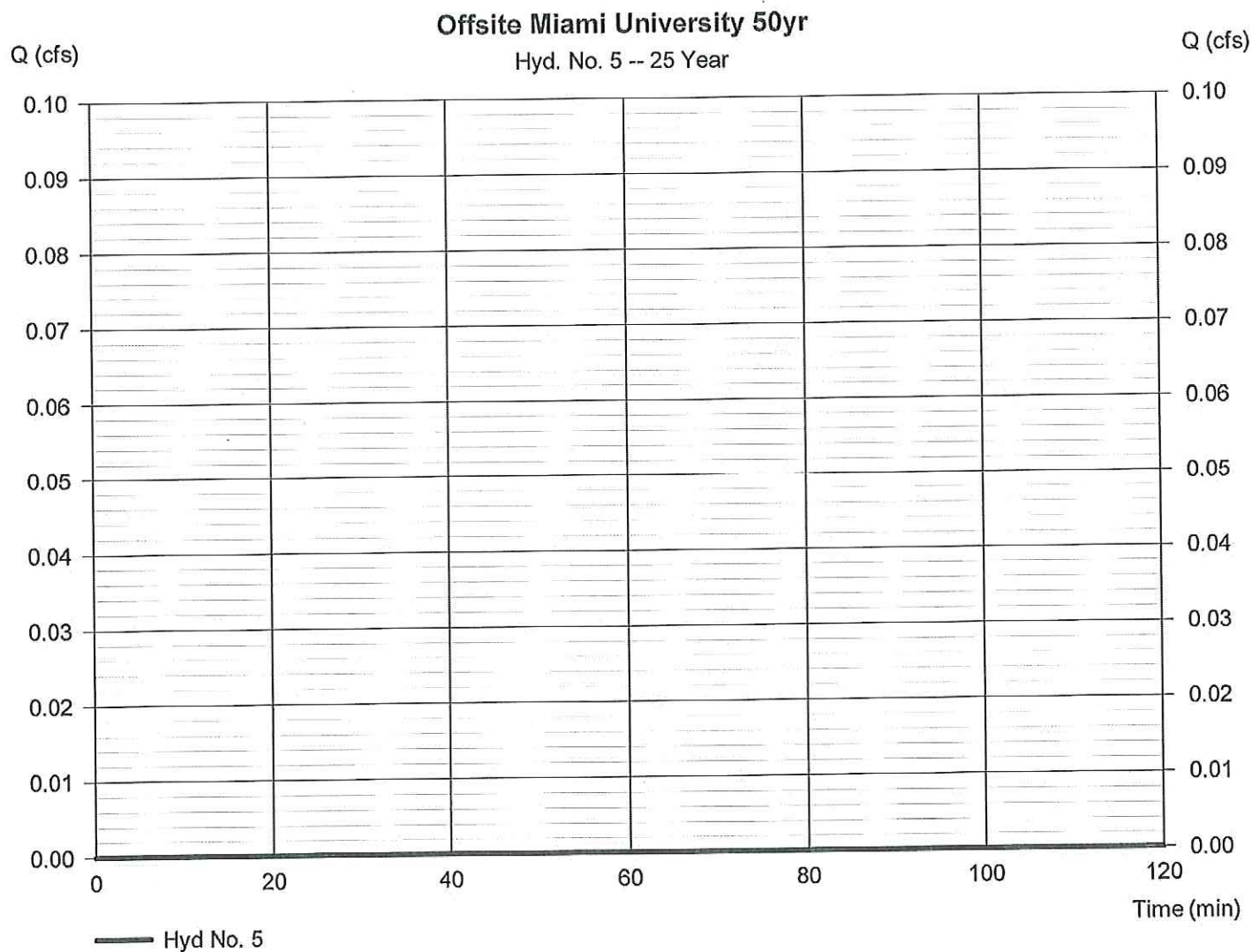
Monday, Apr 16, 2012

Hyd. No. 5

Offsite Miami University 50yr

Hydrograph type = Manual
Storm frequency = 25 yrs
Time interval = 2 min

Peak discharge = 0.000 cfs
Time to peak = n/a
Hyd. volume = 0 cuft



Hydrograph Report

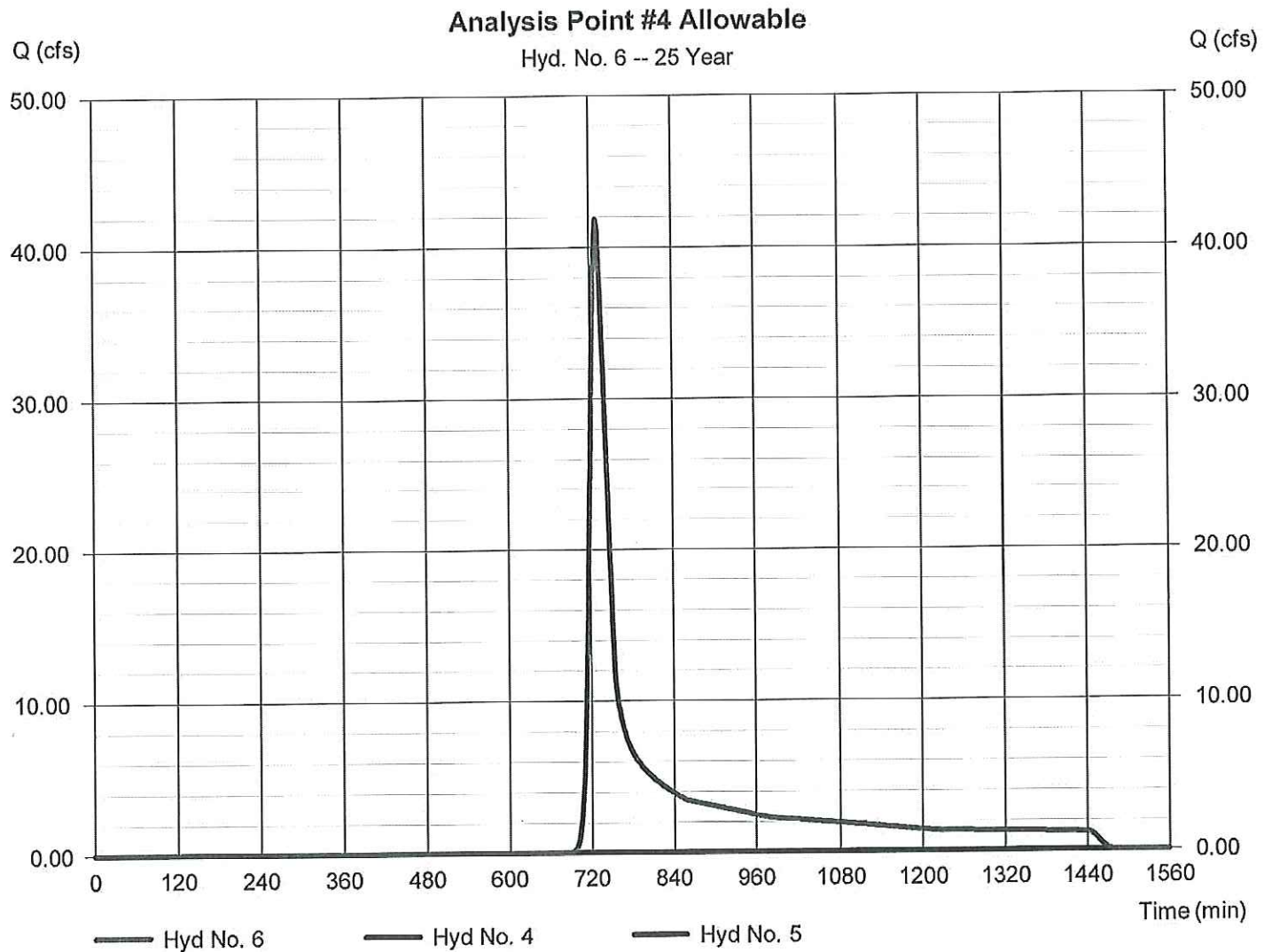
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2011 by Autodesk, Inc. v8

Monday, Apr 16, 2012

Hyd. No. 6

Analysis Point #4 Allowable

Hydrograph type	= Combine	Peak discharge	= 41.88 cfs
Storm frequency	= 25 yrs	Time to peak	= 730 min
Time interval	= 2 min	Hyd. volume	= 173,288 cuft
Inflow hyds.	= 4, 5	Contrib. drain. area	= 39.810 ac



Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2011 by Autodesk, Inc. v8

Monday, Apr 16, 2012

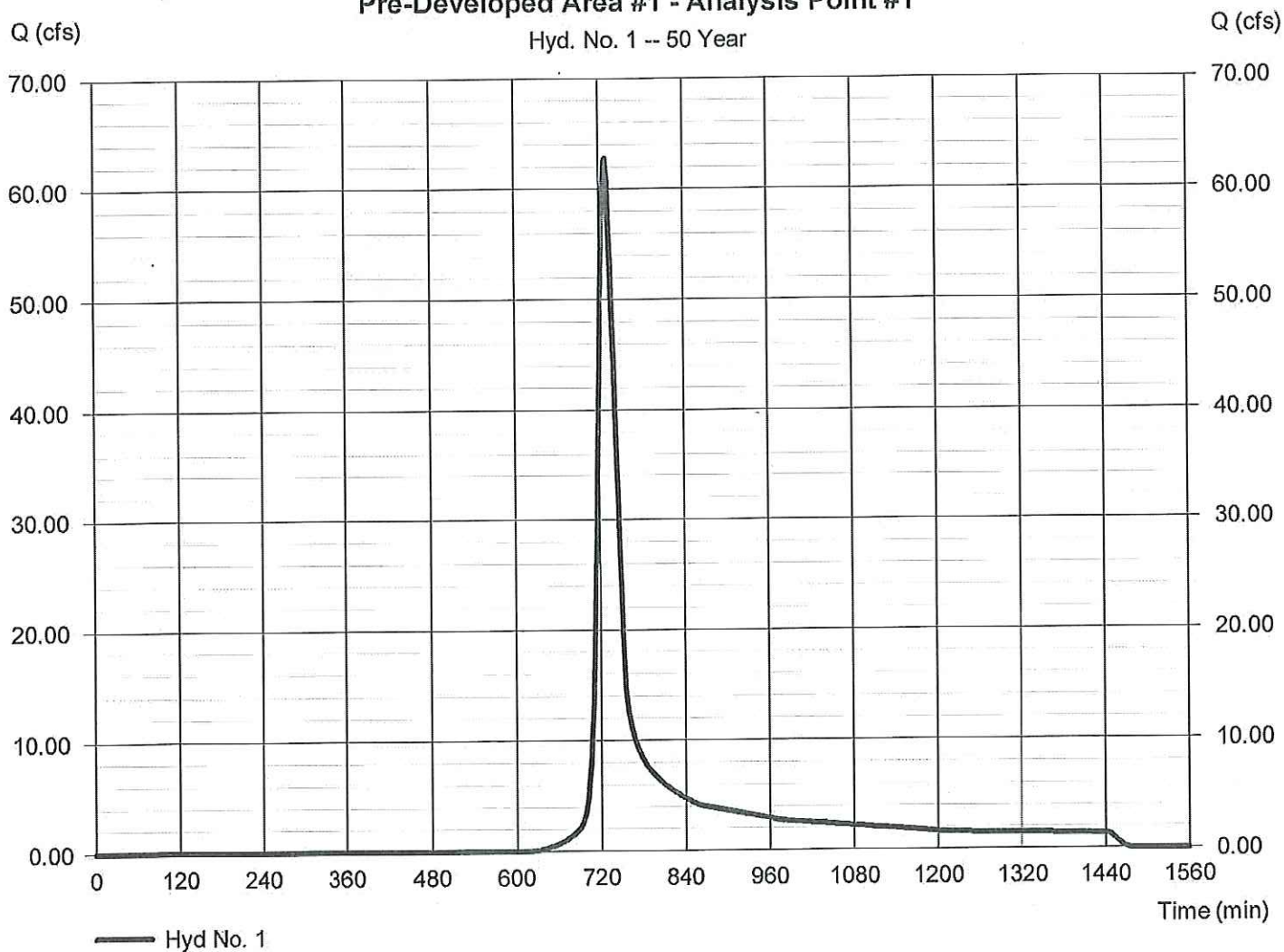
Hyd. No. 1

Pre-Developed Area #1 - Analysis Point #1

Hydrograph type	= SCS Runoff	Peak discharge	= 62.80 cfs
Storm frequency	= 50 yrs	Time to peak	= 730 min
Time interval	= 2 min	Hyd. volume	= 238,052 cuft
Drainage area	= 32.570 ac	Curve number	= 67.2
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 25.20 min
Total precip.	= 5.32 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

Pre-Developed Area #1 - Analysis Point #1

Hyd. No. 1 -- 50 Year



Hydrograph Report

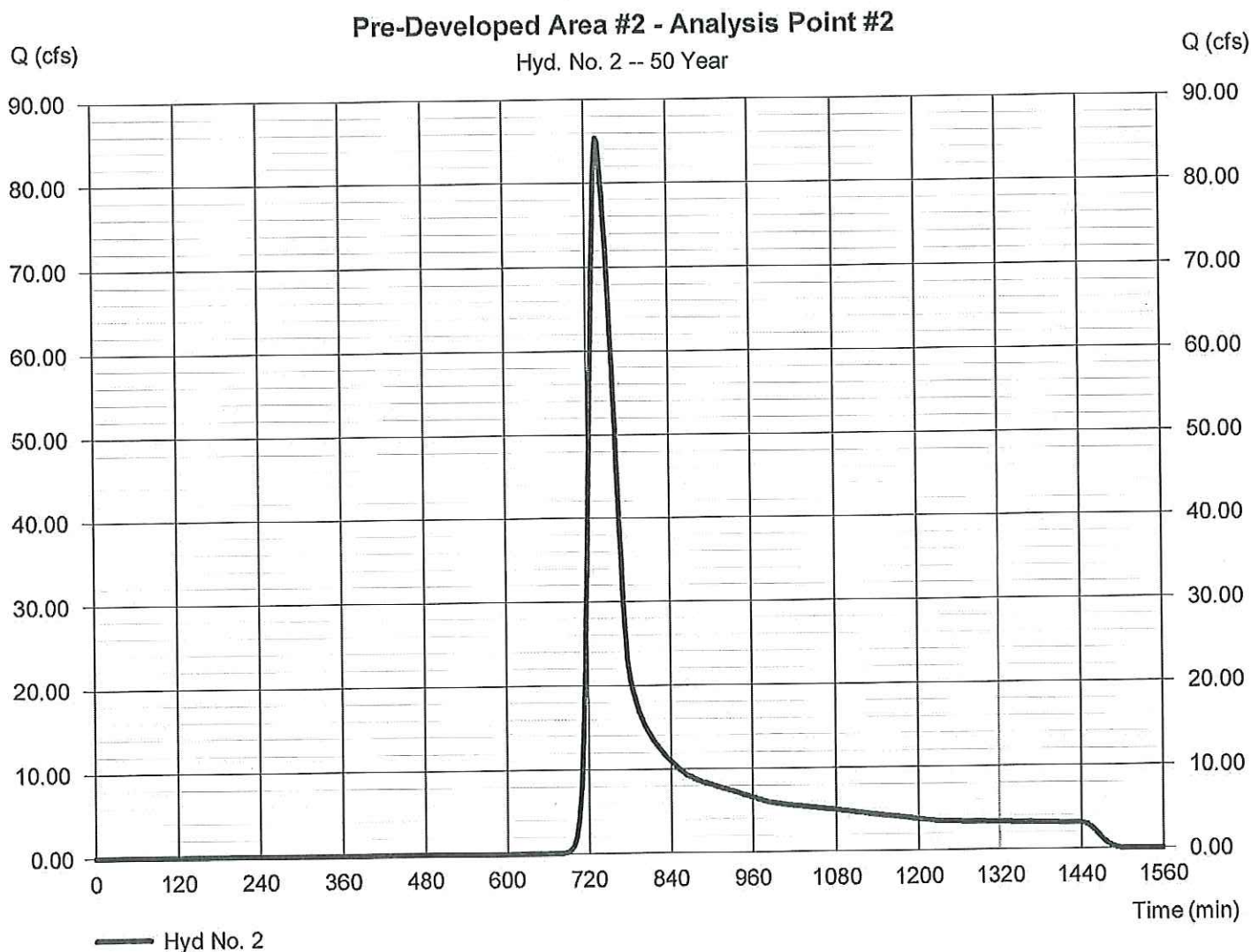
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2011 by Autodesk, Inc. v8

Monday, Apr 16, 2012

Hyd. No. 2

Pre-Developed Area #2 - Analysis Point #2

Hydrograph type	= SCS Runoff	Peak discharge	= 85.37 cfs
Storm frequency	= 50 yrs	Time to peak	= 738 min
Time interval	= 2 min	Hyd. volume	= 461,701 cuft
Drainage area	= 83.620 ac	Curve number	= 60.4
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 37.10 min
Total precip.	= 5.32 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2011 by Autodesk, Inc. v8

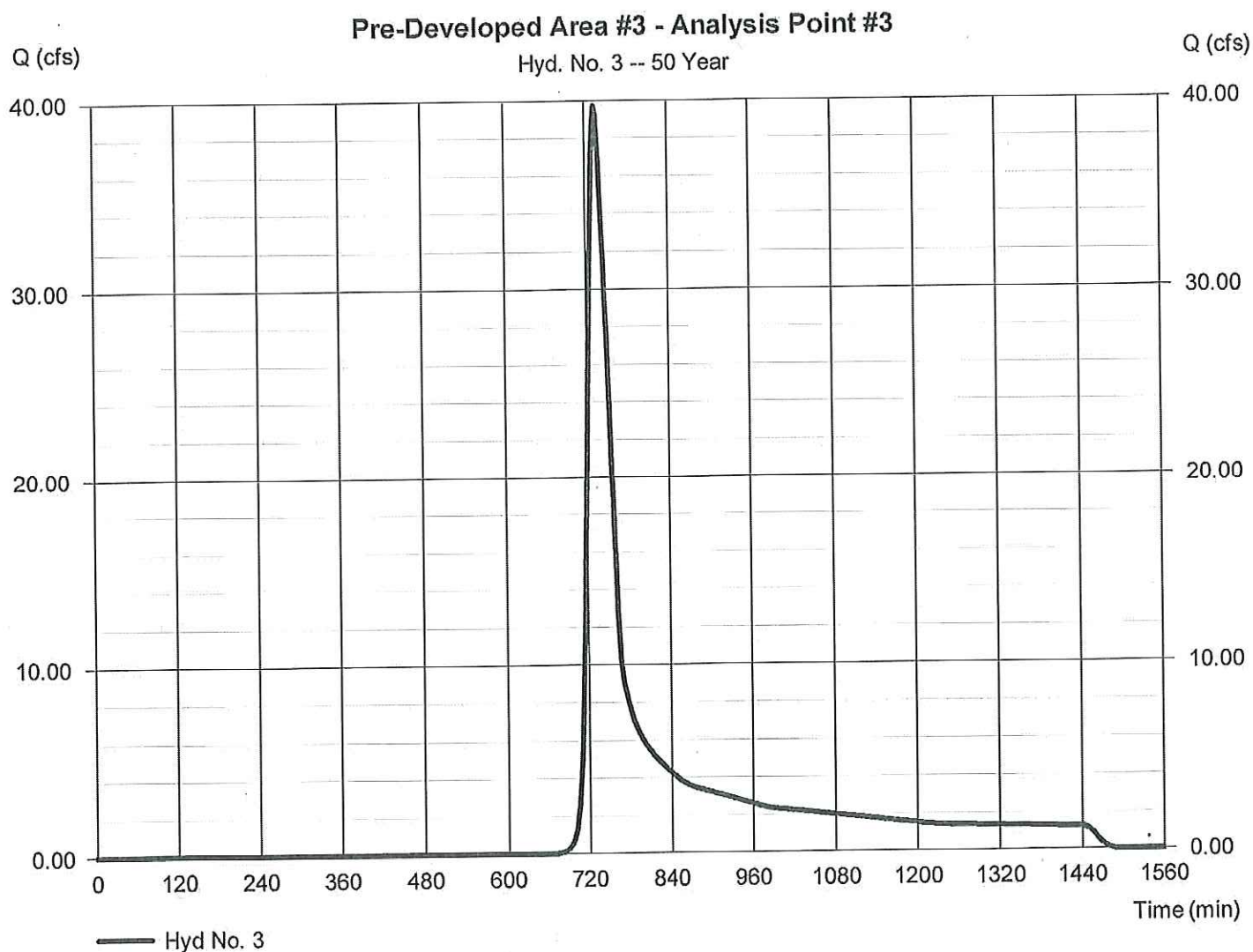
Monday, Apr 16, 2012

Hyd. No. 3

Pre-Developed Area #3 - Analysis Point #3

Hydrograph type = SCS Runoff
Storm frequency = 50 yrs
Time interval = 2 min
Drainage area = 32.220 ac
Basin Slope = 0.0 %
Tc method = User
Total precip. = 5.32 in
Storm duration = 24 hrs

Peak discharge = 39.73 cfs
Time to peak = 734 min
Hyd. volume = 187,980 cuft
Curve number = 61.3
Hydraulic length = 0 ft
Time of conc. (Tc) = 31.30 min
Distribution = Type II
Shape factor = 484



Hydrograph Report

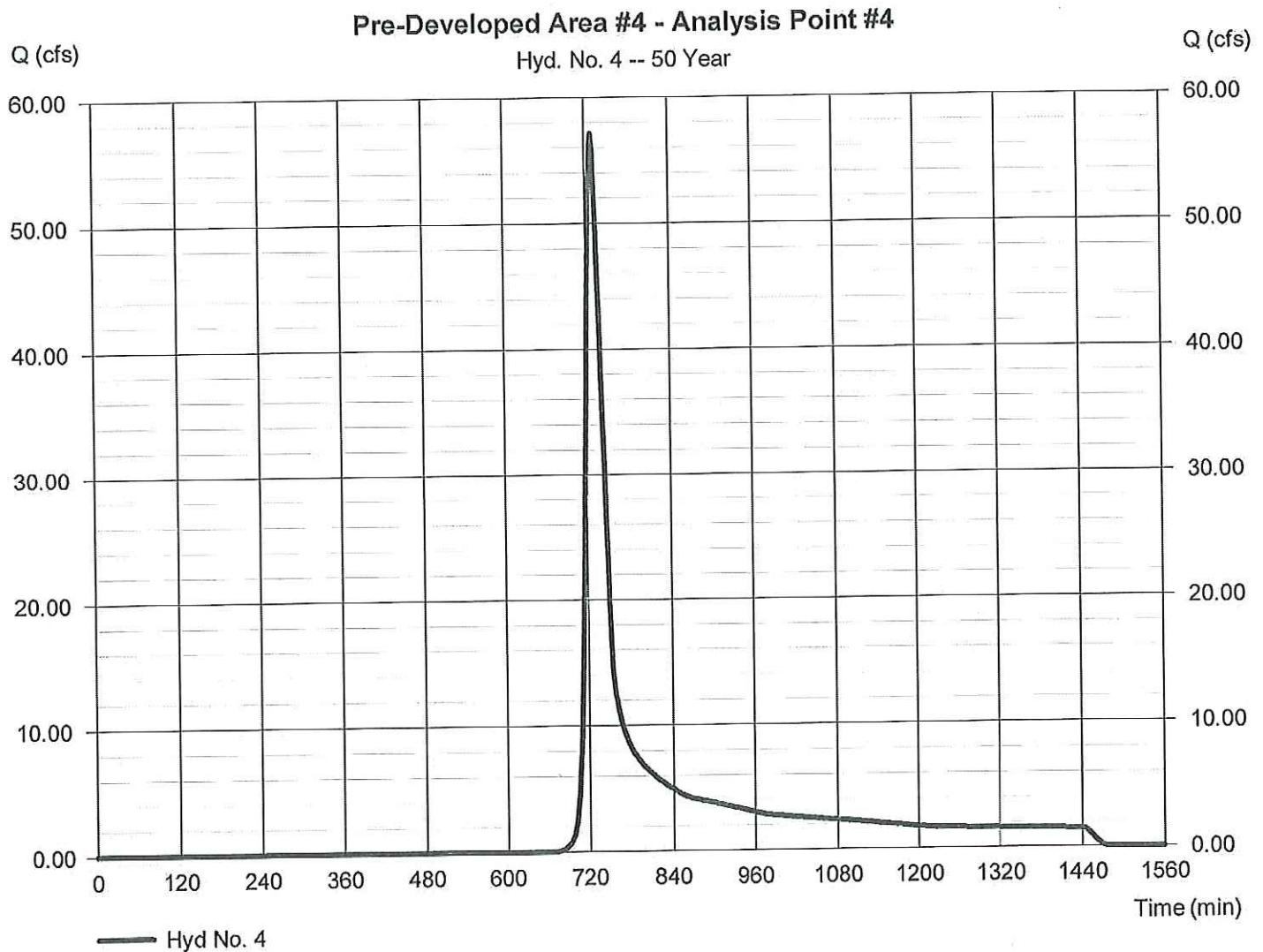
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2011 by Autodesk, Inc. v8

Monday, Apr 16, 2012

Hyd. No. 4

Pre-Developed Area #4 - Analysis Point #4

Hydrograph type	= SCS Runoff	Peak discharge	= 57.14 cfs
Storm frequency	= 50 yrs	Time to peak	= 730 min
Time interval	= 2 min	Hyd. volume	= 226,866 cuft
Drainage area	= 39.810 ac	Curve number	= 61.4
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 26.40 min
Total precip.	= 5.32 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2011 by Autodesk, Inc. v8

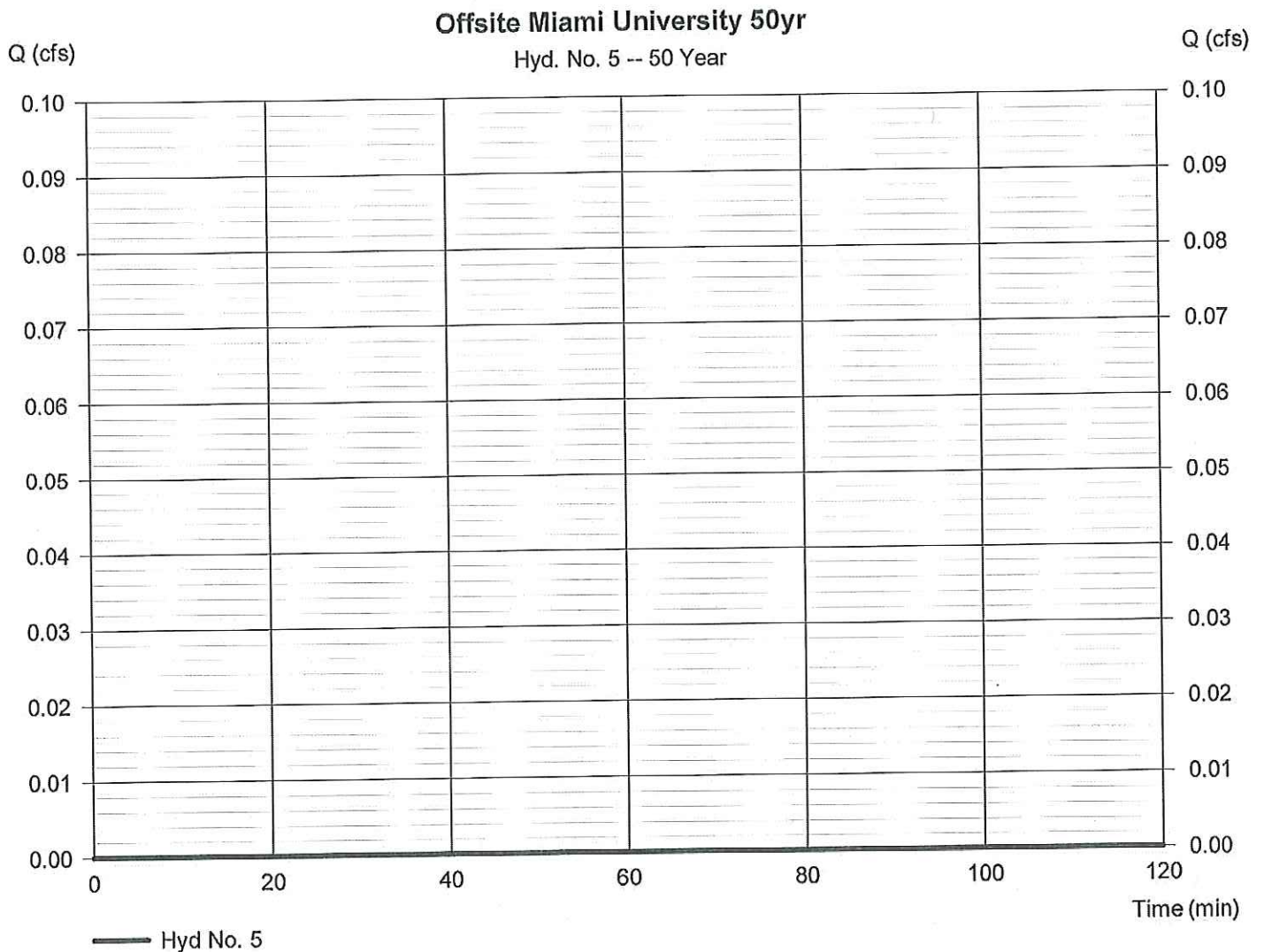
Monday, Apr 16, 2012

Hyd. No. 5

Offsite Miami University 50yr

Hydrograph type = Manual
Storm frequency = 50 yrs
Time interval = 2 min

Peak discharge = 0.000 cfs
Time to peak = n/a
Hyd. volume = 0 cuft



Hydrograph Report

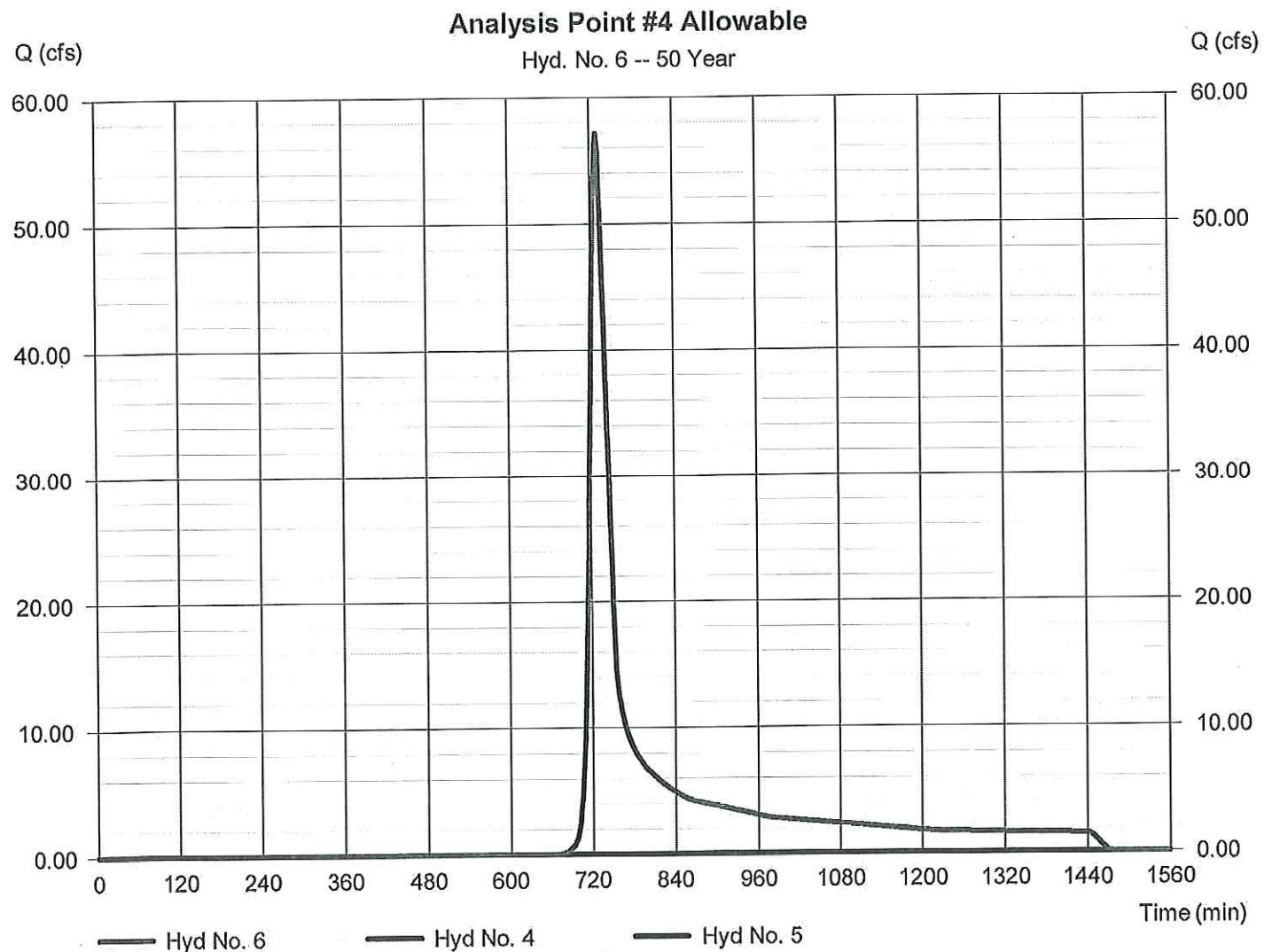
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2011 by Autodesk, Inc. v8

Monday, Apr 16, 2012

Hyd. No. 6

Analysis Point #4 Allowable

Hydrograph type	= Combine	Peak discharge	= 57.14 cfs
Storm frequency	= 50 yrs	Time to peak	= 730 min
Time interval	= 2 min	Hyd. volume	= 226,866 cuft
Inflow hyds.	= 4, 5	Contrib. drain. area	= 39.810 ac



Project: Voice of America Park

Drainage Area Description:

Post-Developed Area #1, Onsite tributary Lake #1 and analysis point #1

Job #: 07M056.006

Initials: GJK

Date: 4/4/2012

Drainage Area: 24.30 Acres

Soil Types: 25 % Type B
75 % Type C

Land Use: Open Space 75 %
Lake 10 %
Impervious 15 %

Composite Runoff Curve Number:

Ground Cover	Soil Type	CN	Soil Type %	Land Use %	
Open Space	B	61	25	75	11.44
Lake	B	100	25	10	2.50
Impervious	B	98	25	15	3.68
Open Space	C	74	75	75	41.63
Lake	C	100	75	10	7.50
Impervious	C	98	75	15	11.03

Composite CN = 77.8

Time of Concentration:

Sheet Flow:

Length = 100

Slope(ft/ft) = 0.0200

Manning's, n = 0.17

Tc
0.19 hr

Shallow Concentrated Flow:

Length = 370

Slope(ft/ft) = 0.0150

Velocity (fps) = 2

0.05 hr

Channel Flow:

Length = 1070

Velocity (fps) = 3

0.10 hr

Pipe Flow:

Length =

Velocity (fps) =

hr

Tc = 0.34 hr
20.5 min

Project: Voice of America Park

Drainage Area Description:

Post-Developed Area #2, Onsite tributary to Lake #2, then Lake #3 and analysis point #2

Job #: 07M056.006

Initials: GJK

Date: 4/4/2012

Drainage Area: 17.60 Acres

Soil Types: 100 % Type B
0 % Type C

Land Use: Open Space 80 %
Lake 8 %
Impervious 12 %

Composite Runoff Curve Number:

Ground Cover	Soil Type	CN	Soil Type %	Land Use %	
Open Space	B	61	100	80	48.80
Lake	B	100	100	8	8.00
Impervious	B	98	100	12	11.76
Open Space	C	74	0	80	0.00
Lake	C	100	0	8	0.00
Impervious	C	98	0	12	0.00

Composite CN = 68.6

Time of Concentration:

Sheet Flow:

Length = 100 Slope(ft/ft) = 0.0150

Manning's, n = 0.17

Tc

0.21 hr

Shallow Concentrated Flow:

Length = 620 Slope(ft/ft) = 0.0150

Velocity (fps) = 2

0.09 hr

Channel Flow:

Length =

Velocity (fps) =

0.00 hr

Pipe Flow:

Length =

Velocity (fps) =

hr

Tc = 0.30 hr
18.0 min

Project: Voice of America Park

Drainage Area Description:

Post-Developed Area #3, Onsite tributary to Lake #3 and analysis point #2

Job #: 07M056.006

Initials: GJK

Date: 4/4/2012

Drainage Area: 63.50 Acres

Soil Types: 30 % Type B
70 % Type C

Land Use: Open Space 49 %
Lake 5 %
Impervious 18 %
Synthetic Turf Fields 28 % (9 Fields Total)

Composite Runoff Curve Number:

Ground Cover	Soil Type	CN	Soil Type %	Land Use %	
Open Space	B	61	30	49	8.97
Lake	B	100	30	5	1.50
Impervious	B	98	30	18	5.29
Synthetic Turf Fields	B	90	30	28	7.56
Open Space	C	74	70	49	25.38
Lake	C	100	70	5	3.50
Impervious	C	98	70	18	12.35
Synthetic Turf Fields	C	90	70	28	17.64

Composite CN = 82.2

Time of Concentration:

Sheet Flow:

Length = 100

Slope(ft/ft) = 0.0200

Manning's, n = 0.17

Tc

0.19 hr

Shallow Concentrated Flow:

Length = 300

Slope(ft/ft) = 0.0150

Velocity (fps) = 2

0.04 hr

Channel Flow:

Length =

Velocity (fps) =

0.00 hr

Pipe Flow:

Length = 930

Velocity (fps) = 5

0.05 hr

Tc = 0.28 hr
17.1 min

Project: Voice of America Park

Drainage Area Description:

Post-Developed Area #4, Onsite tributary to Lake #4 and analysis point #3

Job #: 07M056.006

Initials: GJK

Date: 4/4/2012

Drainage Area: 22.25 Acres

Soil Types: 70 % Type B
30 % Type C

Land Use: Open Space 60 %
Lake 10 %
Impervious 30 %

Composite Runoff Curve Number:

Ground Cover	Soil Type	CN	Soil Type %	Land Use %	
Open Space	B	61	70	60	25.62
Lake	B	100	70	10	7.00
Impervious	B	98	70	30	20.58
Open Space	C	74	30	60	13.32
Lake	C	100	30	10	3.00
Impervious	C	98	30	30	8.82

Composite CN = 78.3

Time of Concentration:

Sheet Flow:

Length = 100

Slope(ft/ft) = 0.0150

Manning's, n = 0.17

Tc
0.21 hr

Shallow Concentrated Flow:

Length = 450

Slope(ft/ft) = 0.0150

Velocity (fps) = 2

0.06 hr

Channel Flow:

Length = 320

Velocity (fps) = 2.5

0.04 hr

Pipe Flow:

Length = 130

Velocity (fps) = 5

0.01 hr

Tc = 0.31 hr
18.7 min

Project: Voice of America Park

Drainage Area Description:

Post-Developed Area #5, Onsite tributary to Lake #5 analysis point #3

Job #: 07M056.006

Initials: GJK

Date: 4/4/2012

Drainage Area: 67.30 Acres

Soil Types: 35 % Type B
65 % Type C

Land Use: Open Space 82 %
Lake 13 %
Impervious 5 %

Composite Runoff Curve Number:

Ground Cover	Soil Type	CN	Soil Type %	Land Use %	
Open Space	B	61	35	82	17.51
Lake	B	100	35	13	4.55
Impervious	B	98	35	5	1.72
Open Space	C	74	65	82	39.44
Lake	C	100	65	13	8.45
Impervious	C	98	65	5	3.19

Composite CN = 74.8

Time of Concentration:

Sheet Flow:

Length = 100

Slope(ft/ft) = 0.0150

Manning's, n = 0.17

Tc

0.21 hr

Shallow Concentrated Flow:

Length = 950

Slope(ft/ft) = 0.0120

Velocity (fps) = 1.8

0.15 hr

Channel Flow:

Length = 100

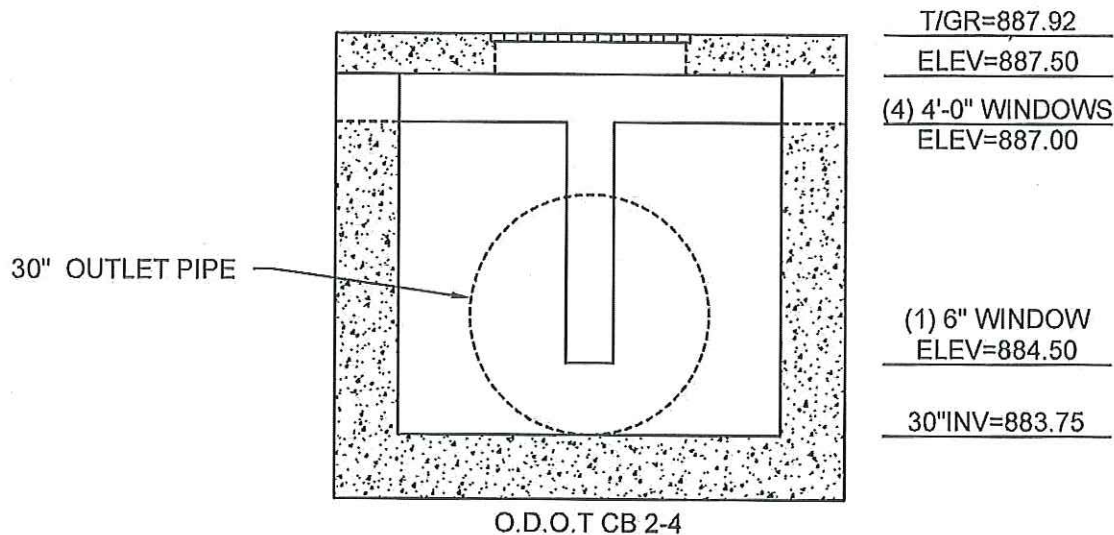
Velocity (fps) = 2.5

0.01 hr

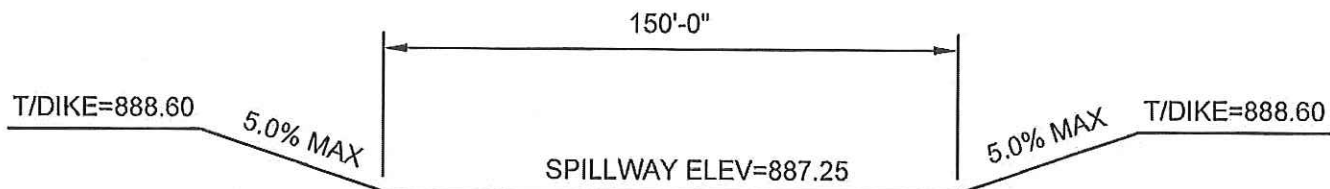
Tc =

0.37 hr

22.3 min



LAKE #1 OUTLET STRUCTURE SIDE VIEW DETAIL N.T.S.



LAKE #1 EMERGENCY SPILLWAY DETAIL N.T.S.

Drawing:
07M056-006 CD
Scale
07M056.006
Drawn by:
GJK
Checked By:
Issue Date:
04-04-12

**VOICE OF AMERICA PARK
ATHLETIC COMPLEX**
SECTION 12, TOWN 3, RANGE 2,
WEST CHESTER TOWNSHIP,
BUTLER COUNTY, OHIO
FUTURE LAKE #1 OUTLET DETAILS

**bayer
becker**
6900 Tylersville Road, Suite A
Mason, OH 45040 - 513.336.6600

Pond Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2011 by Autodesk, Inc. v8

Monday, Apr 16, 2012

Pond No. 1 - Lake #1

Pond Data

Contours -User-defined contour areas. Conic method used for volume calculation. Beginning Elevation = 884.50 ft

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	884.50	00	0	0
0.24	884.74	01	0	0
0.25	884.75	81,066	271	271
0.50	885.00	82,336	20,423	20,694
1.50	886.00	87,471	84,882	105,577
2.50	887.00	92,703	90,065	195,642

Culvert / Orifice Structures

	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 30.00	0.00	0.00	0.00
Span (in)	= 30.00	0.00	0.00	0.00
No. Barrels	= 1	0	0	0
Invert El. (ft)	= 883.75	0.00	0.00	0.00
Length (ft)	= 47.00	0.00	0.00	0.00
Slope (%)	= 0.30	0.00	0.00	n/a
N-Value	= .013	.013	.013	n/a
Orifice Coeff.	= 0.60	0.60	0.60	0.60
Multi-Stage	= n/a	No	No	No

Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	= 0.50	15.50	0.00	0.00
Crest El. (ft)	= 884.50	887.00	0.00	0.00
Weir Coeff.	= 3.00	3.00	3.33	3.33
Weir Type	= Rect	Rect	---	---
Multi-Stage	= Yes	Yes	No	No
Exfil.(in/hr)	= 0.000 (by Contour)			
TW Elev. (ft)	= 0.00			

Note: Culvert/Orifice outflows are analyzed under inlet (ic) and outlet (oc) control. Weir risers checked for orifice conditions (ic) and submergence (s).

Stage / Storage / Discharge Table

Stage ft	Storage cuft	Elevation ft	Clv A cfs	Clv B cfs	Clv C cfs	PrfRsr cfs	Wr A cfs	Wr B cfs	Wr C cfs	Wr D cfs	Exfil cfs	User cfs	Total cfs
0.00	0	884.50	0.00	---	---	---	0.00	0.00	---	---	---	---	0.000
0.02	0	884.52	2.53 oc	---	---	---	0.01	0.00	---	---	---	---	0.006
0.05	0	884.55	2.53 oc	---	---	---	0.02	0.00	---	---	---	---	0.016
0.07	0	884.57	2.53 oc	---	---	---	0.03	0.00	---	---	---	---	0.029
0.10	0	884.60	2.53 oc	---	---	---	0.04	0.00	---	---	---	---	0.045
0.12	0	884.62	2.53 oc	---	---	---	0.06	0.00	---	---	---	---	0.062
0.14	0	884.64	2.53 oc	---	---	---	0.08	0.00	---	---	---	---	0.082
0.17	0	884.67	2.53 oc	---	---	---	0.10	0.00	---	---	---	---	0.103
0.19	0	884.69	2.53 oc	---	---	---	0.13	0.00	---	---	---	---	0.126
0.22	0	884.72	2.53 oc	---	---	---	0.15	0.00	---	---	---	---	0.150
0.24	0	884.74	2.53 oc	---	---	---	0.18	0.00	---	---	---	---	0.176
0.24	27	884.74	2.53 uc	---	---	---	0.18	0.00	---	---	---	---	0.177
0.24	54	884.74	2.53 oc	---	---	---	0.18	0.00	---	---	---	---	0.178
0.24	82	884.74	2.53 oc	---	---	---	0.18	0.00	---	---	---	---	0.180
0.24	109	884.74	2.53 oc	---	---	---	0.18	0.00	---	---	---	---	0.181
0.24	136	884.74	2.53 oc	---	---	---	0.18	0.00	---	---	---	---	0.182
0.25	163	884.75	2.53 oc	---	---	---	0.18	0.00	---	---	---	---	0.183
0.25	190	884.75	2.53 oc	---	---	---	0.18	0.00	---	---	---	---	0.184
0.25	217	884.75	2.53 oc	---	---	---	0.19	0.00	---	---	---	---	0.185
0.25	244	884.75	2.53 oc	---	---	---	0.19	0.00	---	---	---	---	0.186
0.25	271	884.75	2.53 oc	---	---	---	0.19	0.00	---	---	---	---	0.188
0.28	2,314	884.78	2.53 oc	---	---	---	0.22	0.00	---	---	---	---	0.216
0.30	4,356	884.80	2.53 oc	---	---	---	0.25	0.00	---	---	---	---	0.246
0.32	6,398	884.83	2.53 oc	---	---	---	0.28	0.00	---	---	---	---	0.278
0.35	8,441	884.85	2.53 oc	---	---	---	0.31	0.00	---	---	---	---	0.311
0.38	10,483	884.88	2.53 oc	---	---	---	0.34	0.00	---	---	---	---	0.345
0.40	12,525	884.90	2.53 oc	---	---	---	0.38	0.00	---	---	---	---	0.380
0.43	14,568	884.93	2.53 oc	---	---	---	0.42	0.00	---	---	---	---	0.416
0.45	16,610	884.95	2.53 oc	---	---	---	0.45	0.00	---	---	---	---	0.453
0.48	18,652	884.98	2.53 oc	---	---	---	0.49	0.00	---	---	---	---	0.491
0.50	20,694	885.00	2.53 oc	---	---	---	0.53	0.00	---	---	---	---	0.530
0.60	29,183	885.10	2.53 oc	---	---	---	0.70	0.00	---	---	---	---	0.697
0.70	37,671	885.20	2.53 oc	---	---	---	0.88	0.00	---	---	---	---	0.879
0.80	46,159	885.30	2.53 oc	---	---	---	1.07	0.00	---	---	---	---	1.073
0.90	54,647	885.40	2.53 oc	---	---	---	1.28	0.00	---	---	---	---	1.281
1.00	63,136	885.50	2.53 oc	---	---	---	1.50	0.00	---	---	---	---	1.500
1.10	71,624	885.60	2.53 oc	---	---	---	1.73	0.00	---	---	---	---	1.730

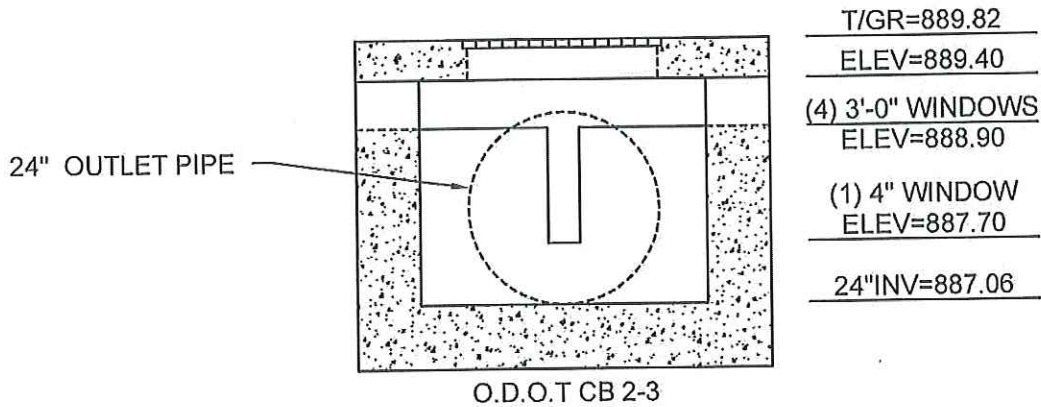
Continues on next page...

Lake #1

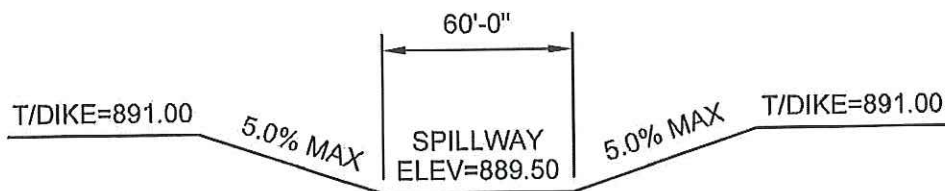
Stage / Storage / Discharge Table

Stage ft	Storage cuft	Elevation ft	Clv A cfs	Clv B cfs	Clv C cfs	PrfRsr cfs	Wr A cfs	Wr B cfs	Wr C cfs	Wr D cfs	Exfil cfs	User cfs	Total cfs
1.20	80,112	885.70	2.53 oc	---	---	---	1.97	0.00	---	---	---	---	1.971
1.30	88,600	885.80	2.53 oc	---	---	---	2.22	0.00	---	---	---	---	2.223
1.40	97,088	885.90	2.53 oc	---	---	---	2.48	0.00	---	---	---	---	2.484
1.50	105,577	886.00	2.82 oc	---	---	---	2.75 s	0.00	---	---	---	---	2.751
1.60	114,583	886.10	3.12 oc	---	---	---	3.02 s	0.00	---	---	---	---	3.019
1.70	123,590	886.20	3.32 oc	---	---	---	3.30 s	0.00	---	---	---	---	3.297
1.80	132,596	886.30	3.64 oc	---	---	---	3.57 s	0.00	---	---	---	---	3.574
1.90	141,603	886.40	3.86 oc	---	---	---	3.86 s	0.00	---	---	---	---	3.860
2.00	150,609	886.50	4.19 oc	---	---	---	4.15 s	0.00	---	---	---	---	4.153
2.10	159,616	886.60	4.53 oc	---	---	---	4.45 s	0.00	---	---	---	---	4.446
2.20	168,622	886.70	4.75 oc	---	---	---	4.75 s	0.00	---	---	---	---	4.753
2.30	177,629	886.80	5.09 oc	---	---	---	5.06 s	0.00	---	---	---	---	5.058
2.40	186,635	886.90	5.44 oc	---	---	---	5.37 s	0.00	---	---	---	---	5.366
2.50	195,642	887.00	5.78 oc	---	---	---	5.68 s	0.00	---	---	---	---	5.680

...End



LAKE #2 OUTLET STRUCTURE SIDE VIEW DETAIL N.T.S.



LAKE #2 EMERGENCY SPILLWAY DETAIL N.T.S.

Drawing:
07M056-006 CD
Scale
07M056.006
Drawn by:
GJK
Checked By:
Issue Date:
04-04-12

**VOICE OF AMERICA PARK
ATHLETIC COMPLEX**
SECTION 12, TOWN 3, RANGE 2,
WEST CHESTER TOWNSHIP,
BUTLER COUNTY, OHIO
LAKE #2 OUTLET DETAILS

**bayer
becker**
6900 Tylersville Road, Suite A
Mason, OH 45040 - 513.336.6600

Pond Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2011 by Autodesk, Inc. v8

Monday, Apr 16, 2012

Pond No. 2 - Lake #2

Pond Data

Contours -User-defined contour areas. Conic method used for volume calculation. Beginning Elevation = 887.70 ft

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	887.70	00	0	0
0.09	887.79	01	0	0
0.10	887.80	55,863	187	187
0.30	888.00	80,959	13,604	13,791
1.30	889.00	110,891	95,524	109,315
2.30	890.00	133,307	121,915	231,230

Culvert / Orifice Structures

	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 24.00	0.00	0.00	0.00
Span (in)	= 24.00	0.00	0.00	0.00
No. Barrels	= 1	0	0	0
Invert El. (ft)	= 887.06	0.00	0.00	0.00
Length (ft)	= 178.00	0.00	0.00	0.00
Slope (%)	= 0.30	0.00	0.00	n/a
N-Value	= .013	.013	.013	n/a
Orifice Coeff.	= 0.60	0.60	0.60	0.60
Multi-Stage	= n/a	No	No	No

Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	= 0.33	11.67	0.00	0.00
Crest El. (ft)	= 887.70	888.90	0.00	0.00
Weir Coeff.	= 3.00	3.00	3.33	3.33
Weir Type	= Rect	Rect	---	---
Multi-Stage	= Yes	Yes	No	No
Exfil.(in/hr)	= 0.000 (by Wet area)			
TW Elev. (ft)	= 0.00			

Note: Culvert/Orifice outflows are analyzed under inlet (ic) and outlet (oc) control. Weir risers checked for orifice conditions (ic) and submergence (s).

Stage / Storage / Discharge Table

Stage ft	Storage cuft	Elevation ft	Clv A cfs	Clv B cfs	Clv C cfs	PrfRsr cfs	Wr A cfs	Wr B cfs	Wr C cfs	Wr D cfs	Exfil cfs	User cfs	Total cfs
0.00	0	887.70	0.00	---	---	---	0.00	0.00	---	---	---	---	0.000
0.01	0	887.71	2.34 oc	---	---	---	0.00	0.00	---	---	---	---	0.001
0.02	0	887.72	2.34 oc	---	---	---	0.00	0.00	---	---	---	---	0.002
0.03	0	887.73	2.34 oc	---	---	---	0.00	0.00	---	---	---	---	0.004
0.04	0	887.74	2.34 oc	---	---	---	0.01	0.00	---	---	---	---	0.007
0.04	0	887.74	2.34 oc	---	---	---	0.01	0.00	---	---	---	---	0.009
0.05	0	887.75	2.34 oc	---	---	---	0.01	0.00	---	---	---	---	0.012
0.06	0	887.76	2.34 oc	---	---	---	0.02	0.00	---	---	---	---	0.016
0.07	0	887.77	2.34 oc	---	---	---	0.02	0.00	---	---	---	---	0.019
0.08	0	887.78	2.34 oc	---	---	---	0.02	0.00	---	---	---	---	0.023
0.09	0	887.79	2.34 oc	---	---	---	0.03	0.00	---	---	---	---	0.027
0.09	19	887.79	2.34 oc	---	---	---	0.03	0.00	---	---	---	---	0.027
0.09	37	887.79	2.34 oc	---	---	---	0.03	0.00	---	---	---	---	0.028
0.09	56	887.79	2.34 oc	---	---	---	0.03	0.00	---	---	---	---	0.028
0.09	75	887.79	2.34 oc	---	---	---	0.03	0.00	---	---	---	---	0.028
0.09	94	887.79	2.34 oc	---	---	---	0.03	0.00	---	---	---	---	0.029
0.10	112	887.80	2.34 oc	---	---	---	0.03	0.00	---	---	---	---	0.029
0.10	131	887.80	2.34 oc	---	---	---	0.03	0.00	---	---	---	---	0.030
0.10	150	887.80	2.34 oc	---	---	---	0.03	0.00	---	---	---	---	0.030
0.10	168	887.80	2.34 oc	---	---	---	0.03	0.00	---	---	---	---	0.031
0.10	187	887.80	2.34 oc	---	---	---	0.03	0.00	---	---	---	---	0.031
0.12	1,548	887.82	2.34 oc	---	---	---	0.04	0.00	---	---	---	---	0.041
0.14	2,908	887.84	2.34 oc	---	---	---	0.05	0.00	---	---	---	---	0.052
0.16	4,268	887.86	2.34 oc	---	---	---	0.06	0.00	---	---	---	---	0.063
0.18	5,629	887.88	2.34 oc	---	---	---	0.08	0.00	---	---	---	---	0.076
0.20	6,989	887.90	2.34 oc	---	---	---	0.09	0.00	---	---	---	---	0.089
0.22	8,350	887.92	2.34 oc	---	---	---	0.10	0.00	---	---	---	---	0.102
0.24	9,710	887.94	2.34 oc	---	---	---	0.12	0.00	---	---	---	---	0.116
0.26	11,071	887.96	2.34 oc	---	---	---	0.13	0.00	---	---	---	---	0.131
0.28	12,431	887.98	2.34 oc	---	---	---	0.15	0.00	---	---	---	---	0.147
0.30	13,791	888.00	2.34 oc	---	---	---	0.16	0.00	---	---	---	---	0.163
0.40	23,344	888.10	2.34 oc	---	---	---	0.25	0.00	---	---	---	---	0.250
0.50	32,896	888.20	2.34 oc	---	---	---	0.35	0.00	---	---	---	---	0.350
0.60	42,449	888.30	2.34 oc	---	---	---	0.46	0.00	---	---	---	---	0.460
0.70	52,001	888.40	2.34 oc	---	---	---	0.58	0.00	---	---	---	---	0.580
0.80	61,553	888.50	2.34 oc	---	---	---	0.71	0.00	---	---	---	---	0.708
0.90	71,106	888.60	2.34 oc	---	---	---	0.85	0.00	---	---	---	---	0.845

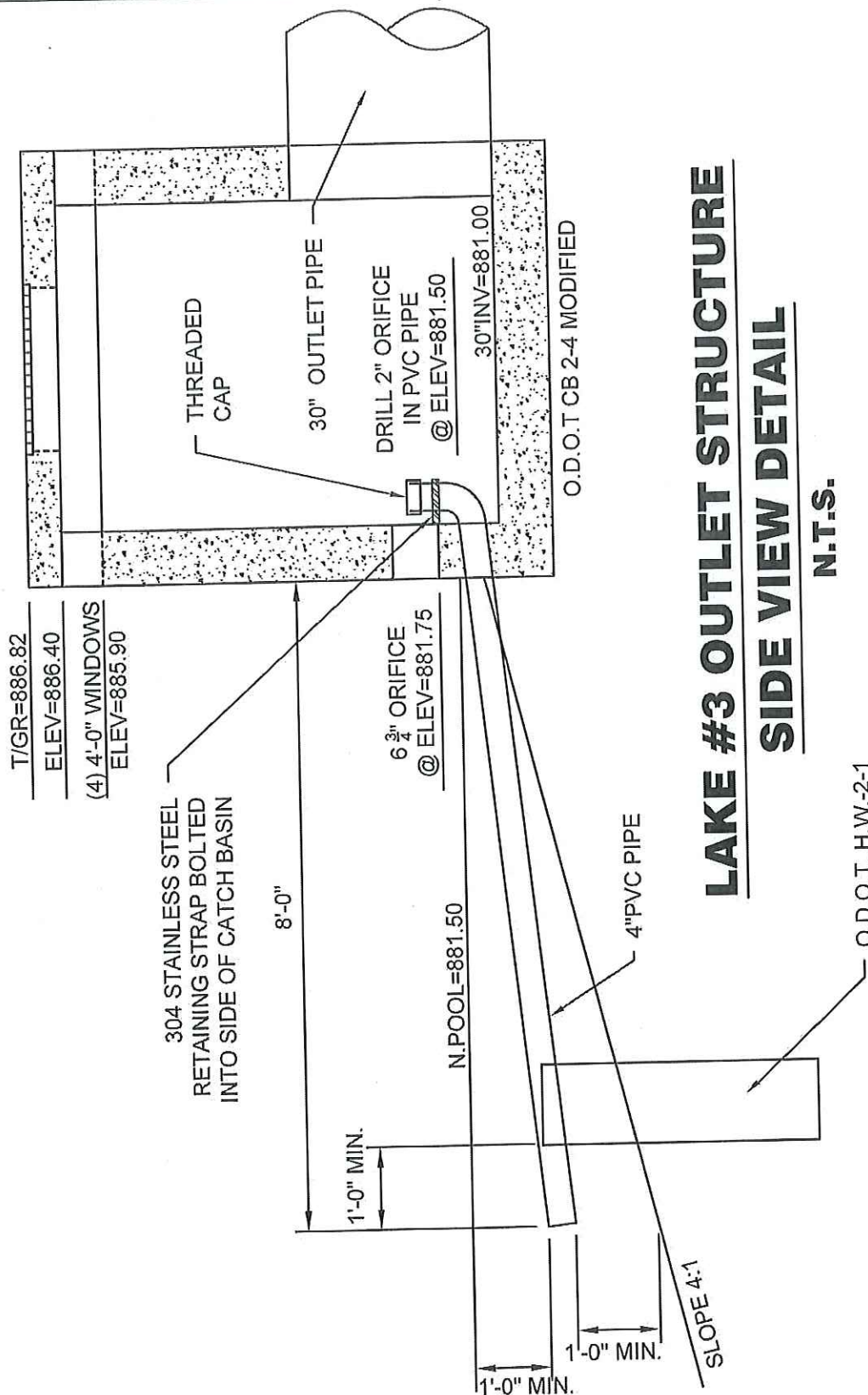
Continues on next page...

Lake #2

Stage / Storage / Discharge Table

Stage ft	Storage cuft	Elevation ft	Clv A cfs	Clv B cfs	Clv C cfs	PrfRsr cfs	Wr A cfs	Wr B cfs	Wr C cfs	Wr D cfs	Exfil cfs	User cfs	Total cfs
1.00	80,658	888.70	2.34 oc	---	---	---	0.99	0.00	---	---	---	---	0.990
1.10	90,211	888.80	2.34 oc	---	---	---	1.14	0.00	---	---	---	---	1.142
1.20	99,763	888.90	2.34 oc	---	---	---	1.30	0.00	---	---	---	---	1.301
1.30	109,315	889.00	2.63 oc	---	---	---	1.46 s	1.11	---	---	---	---	2.571
1.40	121,507	889.10	4.79 oc	---	---	---	1.56 s	3.13	---	---	---	---	4.690
1.50	133,698	889.20	7.33 oc	---	---	---	1.57 s	5.75	---	---	---	---	7.320
1.60	145,890	889.30	9.91 oc	---	---	---	1.26 s	8.65 s	---	---	---	---	9.910
1.70	158,081	889.40	10.79 oc	---	---	---	1.11 s	9.68 s	---	---	---	---	10.79
1.80	170,273	889.50	11.91 oc	---	---	---	1.06 s	10.85 s	---	---	---	---	11.91
1.90	182,464	889.60	12.83 oc	---	---	---	1.03 s	11.81 s	---	---	---	---	12.83
2.00	194,656	889.70	13.64 oc	---	---	---	1.00 s	12.63 s	---	---	---	---	13.63
2.10	206,847	889.80	14.36 oc	---	---	---	0.98 s	13.38 s	---	---	---	---	14.35
2.20	219,039	889.90	15.02 oc	---	---	---	0.96 s	14.05 s	---	---	---	---	15.01
2.30	231,230	890.00	15.63 oc	---	---	---	0.95 s	14.68 s	---	---	---	---	15.63

...End



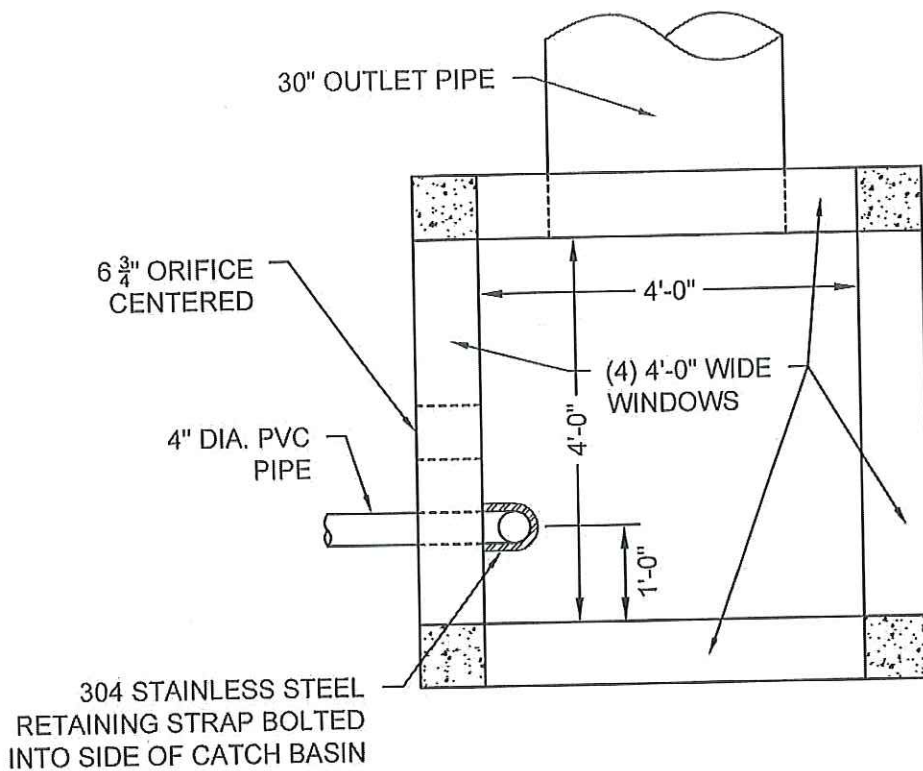
LAKE #3 OUTLET STRUCTURE SIDE VIEW DETAIL

N.T.S.

Drawing:
 07M056-006 CD
 Scale
 07M056.006
 Drawn by:
 GJK
 Checked By:
 Issue Date:
 05-14-12

**VOICE OF AMERICA PARK
 ATHLETIC COMPLEX**
 SECTION 12, TOWN 3, RANGE 2,
 WEST CHESTER TOWNSHIP,
 BUTLER COUNTY, OHIO
LAKE #3 OUTLET DETAILS (1 of 2)

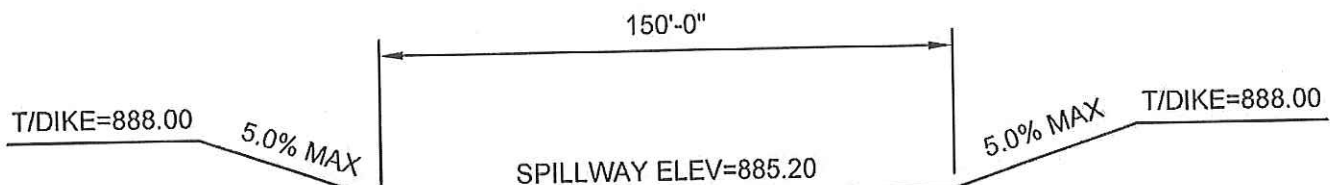
**bayer
 becker**
 6900 Tylersville Road, Suite A
 Mason, OH 45040 - 513.336.6600



LAKE #3 OUTLET STRUCTURE

TOP VIEW DETAIL

N.T.S.



LAKE #3 EMERGENCY SPILLWAY DETAIL

N.T.S.

Drawing:
07M056-006 CD

Scale
07M056.006

Drawn by:
GJK

Checked By:

Issue Date:
05-14-12

**VOICE OF AMERICA PARK
ATHLETIC COMPLEX**

SECTION 12, TOWN 3, RANGE 2,
WEST CHESTER TOWNSHIP,
BUTLER COUNTY, OHIO

LAKE #3 OUTLET DETAILS (2 of 2)

**bayer
becker**

6900 Tylersville Road, Suite A
Mason, OH 45040 - 513.336.6600

Pond Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2011 by Autodesk, Inc. v8

Tuesday, May 15, 2012

Pond No. 3 - Lake #3

Pond Data

Contours -User-defined contour areas. Conic method used for volume calculation. Beginning Elevation = 881.50 ft

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	881.50	00	0	0
0.24	881.74	01	0	0
0.25	881.75	150,658	504	504
0.50	882.00	154,399	38,127	38,631
1.50	883.00	164,258	159,287	197,919
2.50	884.00	174,071	169,124	367,042
3.50	885.00	183,937	178,963	546,006
4.50	886.00	207,023	195,347	741,353
4.80	886.30	210,198	62,576	803,929

Culvert / Orifice Structures

	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 30.00	2.00	6.75	0.00
Span (in)	= 30.00	2.00	6.75	0.00
No. Barrels	= 1	1	1	0
Invert El. (ft)	= 881.00	881.50	881.75	0.00
Length (ft)	= 190.00	0.00	0.00	0.00
Slope (%)	= 0.30	0.00	0.00	n/a
N-Value	= .013	.013	.013	n/a
Orifice Coeff.	= 0.60	0.60	0.60	0.60
Multi-Stage	= n/a	Yes	Yes	No

Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	= 16.00	0.00	0.00	0.00
Crest El. (ft)	= 885.90	0.00	0.00	0.00
Weir Coeff.	= 3.00	3.33	3.33	3.33
Weir Type	= Rect	---	---	---
Multi-Stage	= Yes	No	No	No
Exfil.(in/hr)	= 0.000 (by Wet area)			
TW Elev. (ft)	= 0.00			

Note: Culvert/Orifice outflows are analyzed under inlet (ic) and outlet (oc) control. Weir risers checked for orifice conditions (ic) and submergence (s).

Stage / Storage / Discharge Table

Stage ft	Storage cuft	Elevation ft	Clv A cfs	Clv B cfs	Clv C cfs	PrfRsr cfs	Wr A cfs	Wr B cfs	Wr C cfs	Wr D cfs	Exfil cfs	User cfs	Total cfs
0.00	0	881.50	0.00	0.00	0.00	---	0.00	---	---	---	---	---	0.000
0.02	0	881.52	1.76 ic	0.00 ic	0.00	---	0.00	---	---	---	---	---	0.001
0.05	0	881.55	1.76 ic	0.00 ic	0.00	---	0.00	---	---	---	---	---	0.004
0.07	0	881.57	1.76 ic	0.01 ic	0.00	---	0.00	---	---	---	---	---	0.008
0.10	0	881.60	1.76 ic	0.01 ic	0.00	---	0.00	---	---	---	---	---	0.014
0.12	0	881.62	1.76 ic	0.02 ic	0.00	---	0.00	---	---	---	---	---	0.020
0.14	0	881.64	1.76 ic	0.03 ic	0.00	---	0.00	---	---	---	---	---	0.026
0.17	0	881.67	1.76 ic	0.03 ic	0.00	---	0.00	---	---	---	---	---	0.031
0.19	0	881.69	1.76 ic	0.03 ic	0.00	---	0.00	---	---	---	---	---	0.035
0.22	0	881.72	1.76 ic	0.04 ic	0.00	---	0.00	---	---	---	---	---	0.038
0.24	0	881.74	1.76 ic	0.04 ic	0.00	---	0.00	---	---	---	---	---	0.042
0.24	50	881.74	1.76 ic	0.04 ic	0.00	---	0.00	---	---	---	---	---	0.042
0.24	101	881.74	1.76 ic	0.04 ic	0.00	---	0.00	---	---	---	---	---	0.042
0.24	151	881.74	1.76 ic	0.04 ic	0.00	---	0.00	---	---	---	---	---	0.042
0.24	202	881.74	1.76 ic	0.04 ic	0.00	---	0.00	---	---	---	---	---	0.042
0.24	252	881.74	1.76 ic	0.04 ic	0.00	---	0.00	---	---	---	---	---	0.042
0.25	302	881.75	1.76 ic	0.04 ic	0.00	---	0.00	---	---	---	---	---	0.042
0.25	353	881.75	1.76 ic	0.04 ic	0.00	---	0.00	---	---	---	---	---	0.043
0.25	403	881.75	1.76 ic	0.04 ic	0.00	---	0.00	---	---	---	---	---	0.043
0.25	454	881.75	1.76 ic	0.04 ic	0.00	---	0.00	---	---	---	---	---	0.043
0.25	504	881.75	1.76 ic	0.04 ic	0.00	---	0.00	---	---	---	---	---	0.048
0.28	4,317	881.78	1.76 ic	0.05 ic	0.00 ic	---	0.00	---	---	---	---	---	0.057
0.30	8,129	881.80	1.76 ic	0.05 ic	0.01 ic	---	0.00	---	---	---	---	---	0.070
0.32	11,942	881.83	1.76 ic	0.05 ic	0.02 ic	---	0.00	---	---	---	---	---	0.087
0.35	15,755	881.85	1.76 ic	0.05 ic	0.03 ic	---	0.00	---	---	---	---	---	0.107
0.38	19,568	881.88	1.76 ic	0.06 ic	0.05 ic	---	0.00	---	---	---	---	---	0.132
0.40	23,380	881.90	1.76 ic	0.06 ic	0.07 ic	---	0.00	---	---	---	---	---	0.157
0.43	27,193	881.93	1.76 ic	0.06 ic	0.10 ic	---	0.00	---	---	---	---	---	0.187
0.45	31,006	881.95	1.76 ic	0.06 ic	0.12 ic	---	0.00	---	---	---	---	---	0.219
0.48	34,819	881.98	1.76 ic	0.07 ic	0.15 ic	---	0.00	---	---	---	---	---	0.250
0.50	38,631	882.00	1.76 ic	0.07 ic	0.18 ic	---	0.00	---	---	---	---	---	0.404
0.60	54,560	882.10	1.76 ic	0.08 ic	0.33 ic	---	0.00	---	---	---	---	---	0.569
0.70	70,489	882.20	1.76 ic	0.08 ic	0.49 ic	---	0.00	---	---	---	---	---	0.713
0.80	86,418	882.30	1.76 ic	0.09 ic	0.62 ic	---	0.00	---	---	---	---	---	

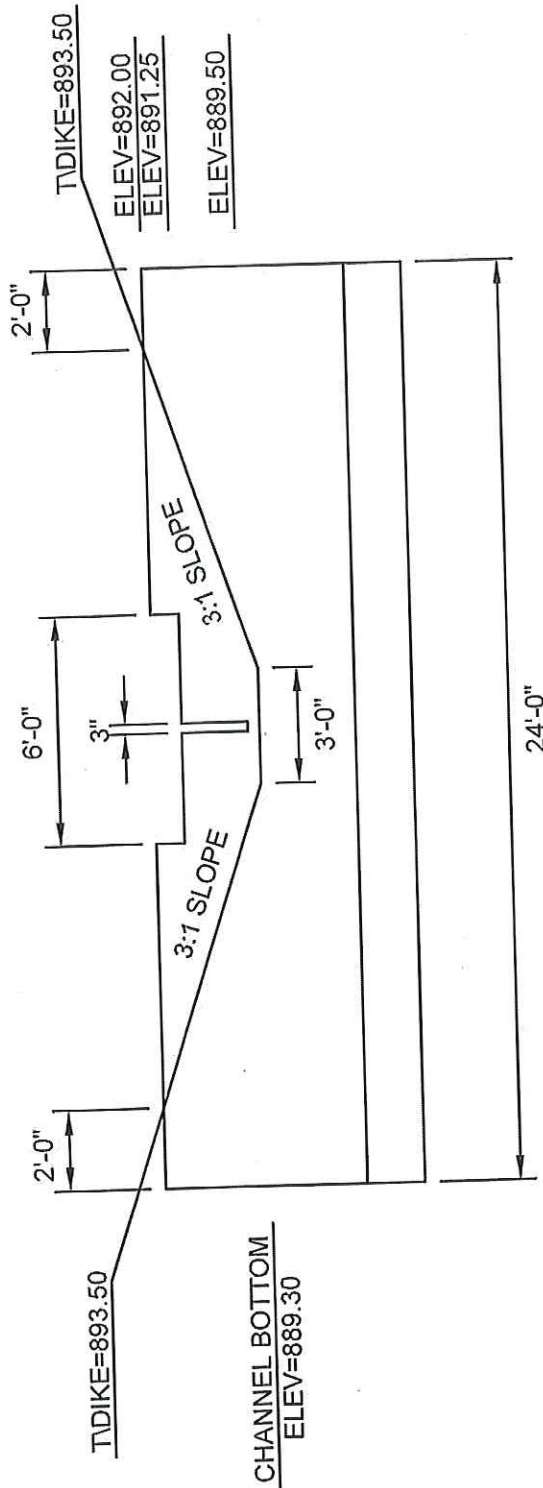
Continues on next page...

Lake #3

Stage / Storage / Discharge Table

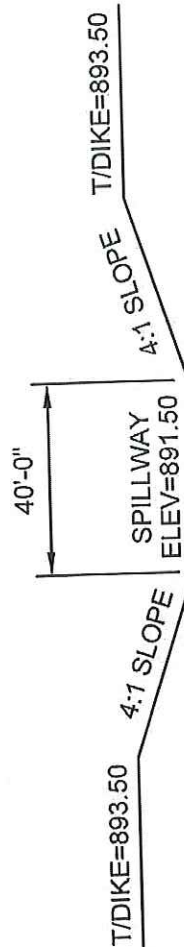
Stage ft	Storage cuft	Elevation ft	Clv A cfs	Clv B cfs	Clv C cfs	PrfRsr cfs	Wr A cfs	Wr B cfs	Wr C cfs	Wr D cfs	Exfil cfs	User cfs	Total cfs
0.90	102,346	882.40	1.76 ic	0.09 ic	0.73 ic	---	0.00	---	---	---	---	---	0.821
1.00	118,275	882.50	1.76 ic	0.10 ic	0.82 ic	---	0.00	---	---	---	---	---	0.920
1.10	134,204	882.60	1.76 ic	0.11 ic	0.90 ic	---	0.00	---	---	---	---	---	1.008
1.20	150,132	882.70	1.76 ic	0.11 ic	0.98 ic	---	0.00	---	---	---	---	---	1.089
1.30	166,061	882.80	1.76 ic	0.12 ic	1.05 ic	---	0.00	---	---	---	---	---	1.165
1.40	181,990	882.90	1.76 ic	0.12 ic	1.11 ic	---	0.00	---	---	---	---	---	1.235
1.50	197,919	883.00	1.76 ic	0.13 ic	1.18 ic	---	0.00	---	---	---	---	---	1.303
1.60	214,831	883.10	1.76 ic	0.13 ic	1.24 ic	---	0.00	---	---	---	---	---	1.366
1.70	231,743	883.20	1.76 ic	0.13 ic	1.29 ic	---	0.00	---	---	---	---	---	1.427
1.80	248,656	883.30	1.76 ic	0.14 ic	1.35 ic	---	0.00	---	---	---	---	---	1.485
1.90	265,568	883.40	1.76 ic	0.14 ic	1.40 ic	---	0.00	---	---	---	---	---	1.541
2.00	282,480	883.50	1.76 ic	0.15 ic	1.45 ic	---	0.00	---	---	---	---	---	1.595
2.10	299,393	883.60	1.76 ic	0.15 ic	1.50 ic	---	0.00	---	---	---	---	---	1.648
2.20	316,305	883.70	1.76 ic	0.15 ic	1.55 ic	---	0.00	---	---	---	---	---	1.698
2.30	333,218	883.80	1.76 ic	0.16 ic	1.59 ic	---	0.00	---	---	---	---	---	1.747
2.40	350,130	883.90	1.86 ic	0.16 ic	1.64 ic	---	0.00	---	---	---	---	---	1.795
2.50	367,042	884.00	1.86 ic	0.16 ic	1.68 ic	---	0.00	---	---	---	---	---	1.842
2.60	384,939	884.10	1.89 ic	0.17 ic	1.72 ic	---	0.00	---	---	---	---	---	1.887
2.70	402,835	884.20	1.97 ic	0.17 ic	1.76 ic	---	0.00	---	---	---	---	---	1.932
2.80	420,731	884.30	1.98 ic	0.17 ic	1.80 ic	---	0.00	---	---	---	---	---	1.975
2.90	438,628	884.40	2.09 ic	0.18 ic	1.84 ic	---	0.00	---	---	---	---	---	2.018
3.00	456,524	884.50	2.09 ic	0.18 ic	1.88 ic	---	0.00	---	---	---	---	---	2.059
3.10	474,420	884.60	2.10 ic	0.18 ic	1.92 ic	---	0.00	---	---	---	---	---	2.100
3.20	492,317	884.70	2.21 ic	0.19 ic	1.95 ic	---	0.00	---	---	---	---	---	2.140
3.30	510,213	884.80	2.21 ic	0.19 ic	1.99 ic	---	0.00	---	---	---	---	---	2.179
3.40	528,110	884.90	2.22 ic	0.19 ic	2.03 ic	---	0.00	---	---	---	---	---	2.218
3.50	546,006	885.00	2.33 ic	0.19 ic	2.06 ic	---	0.00	---	---	---	---	---	2.256
3.60	565,541	885.10	2.33 ic	0.20 ic	2.10 ic	---	0.00	---	---	---	---	---	2.293
3.70	585,075	885.20	2.33 ic	0.20 ic	2.13 ic	---	0.00	---	---	---	---	---	2.329
3.80	604,610	885.30	2.37 ic	0.20 ic	2.16 ic	---	0.00	---	---	---	---	---	2.365
3.90	624,145	885.40	2.46 ic	0.20 ic	2.20 ic	---	0.00	---	---	---	---	---	2.401
4.00	643,679	885.50	2.46 ic	0.21 ic	2.23 ic	---	0.00	---	---	---	---	---	2.436
4.10	663,214	885.60	2.47 ic	0.21 ic	2.26 ic	---	0.00	---	---	---	---	---	2.470
4.20	682,749	885.70	2.59 ic	0.21 ic	2.29 ic	---	0.00	---	---	---	---	---	2.504
4.30	702,283	885.80	2.59 ic	0.21 ic	2.32 ic	---	0.00	---	---	---	---	---	2.537
4.40	721,818	885.90	2.59 ic	0.22 ic	2.35 ic	---	0.00	---	---	---	---	---	2.571
4.50	741,353	886.00	4.24 oc	0.22 ic	2.38 ic	---	1.52	---	---	---	---	---	4.116
4.53	747,610	886.03	4.91 oc	0.21 ic	2.39 ic	---	2.25	---	---	---	---	---	4.856
4.56	753,868	886.06	5.79 oc	0.21 ic	2.40 ic	---	3.07	---	---	---	---	---	5.688
4.59	760,125	886.09	6.72 oc	0.21 ic	2.40 ic	---	3.98	---	---	---	---	---	6.585
4.62	766,383	886.12	7.68 oc	0.21 ic	2.38 ic	---	4.96	---	---	---	---	---	7.542
4.65	772,641	886.15	8.65 oc	0.21 ic	2.36 ic	---	6.00	---	---	---	---	---	8.566
4.68	778,898	886.18	9.82 oc	0.20 ic	2.33 ic	---	7.12	---	---	---	---	---	9.652
4.71	785,156	886.21	10.95 oc	0.20 ic	2.30 ic	---	8.29	---	---	---	---	---	10.80
4.74	791,414	886.24	12.04 oc	0.20 ic	2.28 ic	---	9.52	---	---	---	---	---	12.00
4.77	797,671	886.27	13.37 oc	0.20 ic	2.24 ic	---	10.82	---	---	---	---	---	13.25
4.80	803,929	886.30	14.65 oc	0.19 ic	2.20 ic	---	12.14	---	---	---	---	---	14.53

...End



LAKE #4 OUTLET STRUCTURE DETAIL

N.T.S.



LAKE #4 EMERGENCY SPILLWAY DETAIL

N.T.S.

Drawing:
07M056-006 CD
Scale
07M056.006
Drawn by:
GJK
Checked By:
Issue Date:
04-04-12

VOICE OF AMERICA PARK ATHLETIC COMPLEX

SECTION 12, TOWN 3, RANGE 2,
WEST CHESTER TOWNSHIP,
BUTLER COUNTY, OHIO

LAKE #4 OUTLET DETAILS

**bayer
becker**

6900 Tylersville Road, Suite A
Mason, OH 45040 - 513.336.6600

Pond Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2011 by Autodesk, Inc. v8

Monday, Apr 16, 2012

Pond No. 4 - Lake #4

Pond Data

Contours - User-defined contour areas. Conic method used for volume calculation. Beginning Elevation = 889.50 ft

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	889.50	00	0	0
0.09	889.59	01	0	0
0.10	889.60	101,215	337	337
0.50	890.00	103,743	40,989	41,326
1.50	891.00	110,129	106,909	148,235
2.50	892.00	116,611	113,343	261,578
3.50	893.00	123,187	119,872	381,450
4.00	893.50	126,512	62,417	443,867

Culvert / Orifice Structures

	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 0.00	0.00	0.00	0.00
Span (in)	= 0.00	0.00	0.00	0.00
No. Barrels	= 0	0	0	0
Invert El. (ft)	= 0.00	0.00	0.00	0.00
Length (ft)	= 0.00	0.00	0.00	0.00
Slope (%)	= 0.00	0.00	0.00	n/a
N-Value	= .013	.013	.013	n/a
Orifice Coeff.	= 0.60	0.60	0.60	0.60
Multi-Stage	= n/a	No	No	No

Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	= 0.25	5.75	0.00	0.00
Crest El. (ft)	= 889.50	891.25	0.00	0.00
Weir Coeff.	= 3.00	3.00	3.33	3.33
Weir Type	= Recl	Recl	---	---
Multi-Stage	= No	No	No	No
Exfil.(in/hr)	= 0.000 (by Wet area)			
TW Elev. (ft)	= 0.00			

Note: Culvert/Orifice outflows are analyzed under inlet (ic) and outlet (oc) control. Weir risers checked for orifice conditions (ic) and submergence (s).

Stage / Storage / Discharge Table

Stage ft	Storage cuft	Elevation ft	Clv A cfs	Clv B cfs	Clv C cfs	PrfRsr cfs	Wr A cfs	Wr B cfs	Wr C cfs	Wr D cfs	Exfil cfs	User cfs	Total cfs
0.00	0	889.50	---	---	---	---	0.00	0.00	---	---	---	---	0.000
0.01	0	889.51	---	---	---	---	0.00	0.00	---	---	---	---	0.001
0.02	0	889.52	---	---	---	---	0.00	0.00	---	---	---	---	0.002
0.03	0	889.53	---	---	---	---	0.00	0.00	---	---	---	---	0.003
0.04	0	889.54	---	---	---	---	0.01	0.00	---	---	---	---	0.005
0.05	0	889.55	---	---	---	---	0.01	0.00	---	---	---	---	0.007
0.06	0	889.56	---	---	---	---	0.01	0.00	---	---	---	---	0.009
0.07	0	889.57	---	---	---	---	0.01	0.00	---	---	---	---	0.012
0.08	0	889.58	---	---	---	---	0.02	0.00	---	---	---	---	0.015
0.09	0	889.59	---	---	---	---	0.02	0.00	---	---	---	---	0.017
0.09	34	889.59	---	---	---	---	0.02	0.00	---	---	---	---	0.020
0.09	67	889.59	---	---	---	---	0.02	0.00	---	---	---	---	0.021
0.09	101	889.59	---	---	---	---	0.02	0.00	---	---	---	---	0.021
0.09	135	889.59	---	---	---	---	0.02	0.00	---	---	---	---	0.021
0.10	168	889.59	---	---	---	---	0.02	0.00	---	---	---	---	0.022
0.10	202	889.60	---	---	---	---	0.02	0.00	---	---	---	---	0.022
0.10	236	889.60	---	---	---	---	0.02	0.00	---	---	---	---	0.023
0.10	269	889.60	---	---	---	---	0.02	0.00	---	---	---	---	0.023
0.10	303	889.60	---	---	---	---	0.02	0.00	---	---	---	---	0.023
0.10	337	889.60	---	---	---	---	0.02	0.00	---	---	---	---	0.024
0.14	4,436	889.64	---	---	---	---	0.04	0.00	---	---	---	---	0.039
0.18	8,535	889.68	---	---	---	---	0.06	0.00	---	---	---	---	0.057
0.22	12,633	889.72	---	---	---	---	0.08	0.00	---	---	---	---	0.077
0.26	16,732	889.76	---	---	---	---	0.10	0.00	---	---	---	---	0.099
0.30	20,831	889.80	---	---	---	---	0.12	0.00	---	---	---	---	0.123
0.34	24,930	889.84	---	---	---	---	0.15	0.00	---	---	---	---	0.149
0.38	29,029	889.88	---	---	---	---	0.18	0.00	---	---	---	---	0.176
0.42	33,128	889.92	---	---	---	---	0.20	0.00	---	---	---	---	0.204
0.46	37,227	889.96	---	---	---	---	0.23	0.00	---	---	---	---	0.234
0.50	41,326	890.00	---	---	---	---	0.27	0.00	---	---	---	---	0.265
0.60	52,017	890.10	---	---	---	---	0.35	0.00	---	---	---	---	0.349
0.70	62,708	890.20	---	---	---	---	0.44	0.00	---	---	---	---	0.439
0.80	73,398	890.30	---	---	---	---	0.54	0.00	---	---	---	---	0.537
0.90	84,089	890.40	---	---	---	---	0.64	0.00	---	---	---	---	0.640

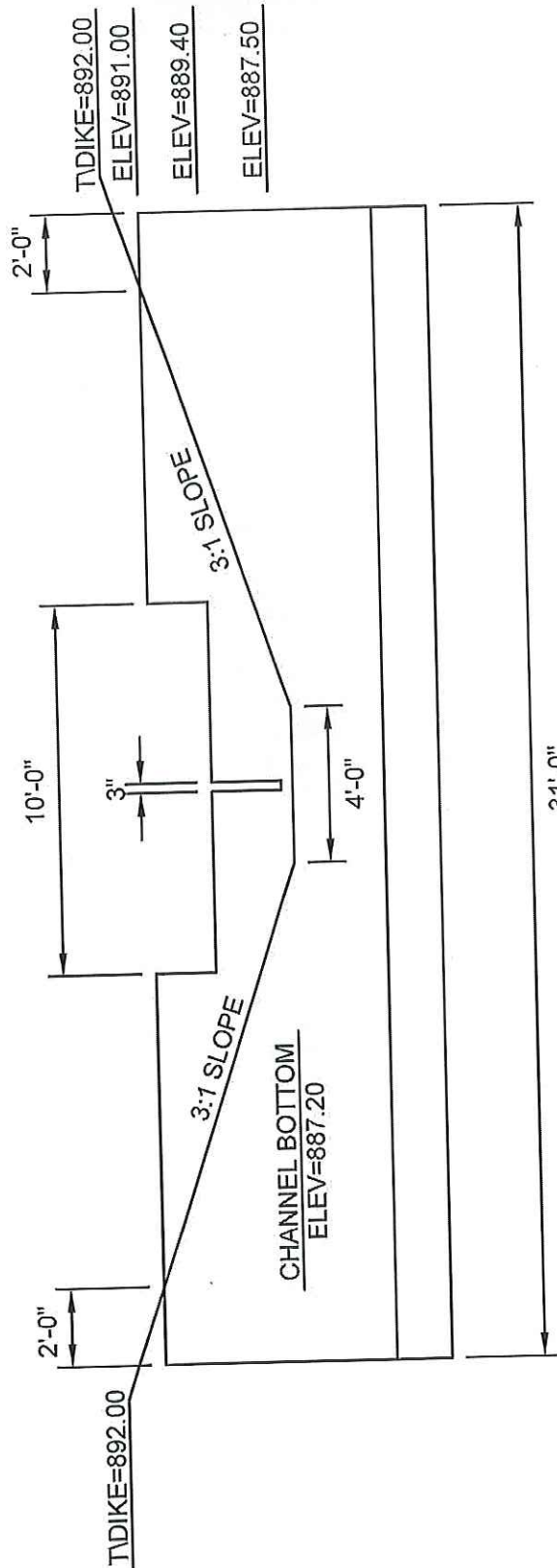
Continues on next page...

Lake #4

Stage / Storage / Discharge Table

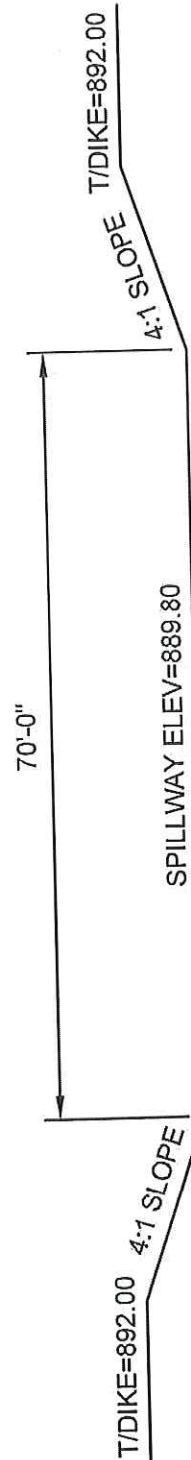
Stage ft	Storage cuft	Elevation ft	Clv A cfs	Clv B cfs	Clv C cfs	PrfRsr cfs	Wr A cfs	Wr B cfs	Wr C cfs	Wr D cfs	Exfil cfs	User cfs	Total cfs
							0.75	0.00	---	---	---	---	0.750
1.00	94,780	890.50	---	---	---	---	0.87	0.00	---	---	---	---	0.865
1.10	105,471	890.60	---	---	---	---	0.99	0.00	---	---	---	---	0.986
1.20	116,162	890.70	---	---	---	---	1.11	0.00	---	---	---	---	1.111
1.30	126,853	890.80	---	---	---	---	1.24	0.00	---	---	---	---	1.242
1.40	137,544	890.90	---	---	---	---	1.38	0.00	---	---	---	---	1.378
1.50	148,235	891.00	---	---	---	---	1.52	0.00	---	---	---	---	1.518
1.60	159,569	891.10	---	---	---	---	1.66	0.00	---	---	---	---	1.662
1.70	170,904	891.20	---	---	---	---	1.81	0.19	---	---	---	---	2.004
1.80	182,238	891.30	---	---	---	---	1.96	1.00	---	---	---	---	2.965
1.90	193,572	891.40	---	---	---	---	2.12	2.15	---	---	---	---	4.276
2.00	204,907	891.50	---	---	---	---	2.28	3.57	---	---	---	---	5.852
2.10	216,241	891.60	---	---	---	---	2.45	5.20	---	---	---	---	7.651
2.20	227,575	891.70	---	---	---	---	2.62	7.03	---	---	---	---	9.648
2.30	238,910	891.80	---	---	---	---	2.79	9.04	---	---	---	---	11.82
2.40	250,244	891.90	---	---	---	---	2.96	11.20	---	---	---	---	14.17
2.50	261,578	892.00	---	---	---	---	3.14	13.52	---	---	---	---	16.66
2.60	273,566	892.10	---	---	---	---	3.33	15.97	---	---	---	---	19.30
2.70	285,553	892.20	---	---	---	---	3.51	18.56	---	---	---	---	22.07
2.80	297,540	892.30	---	---	---	---	3.70	21.27	---	---	---	---	24.97
2.90	309,527	892.40	---	---	---	---	3.90	24.10	---	---	---	---	28.00
3.00	321,514	892.50	---	---	---	---	4.09	27.05	---	---	---	---	31.15
3.10	333,501	892.60	---	---	---	---	4.29	30.11	---	---	---	---	34.41
3.20	345,489	892.70	---	---	---	---	4.50	33.28	---	---	---	---	37.78
3.30	357,476	892.80	---	---	---	---	4.70	36.55	---	---	---	---	41.25
3.40	369,463	892.90	---	---	---	---	4.91	39.93	---	---	---	---	44.85
3.50	381,450	893.00	---	---	---	---	5.02	41.66	---	---	---	---	46.67
3.55	387,692	893.05	---	---	---	---	5.12	43.40	---	---	---	---	48.53
3.60	393,934	893.10	---	---	---	---	5.23	45.18	---	---	---	---	50.41
3.65	400,175	893.15	---	---	---	---	5.34	46.97	---	---	---	---	52.31
3.70	406,417	893.20	---	---	---	---	5.45	48.79	---	---	---	---	54.23
3.75	412,659	893.25	---	---	---	---	5.56	50.63	---	---	---	---	56.18
3.80	418,900	893.30	---	---	---	---	5.67	52.49	---	---	---	---	58.16
3.85	425,142	893.35	---	---	---	---	5.78	54.38	---	---	---	---	60.15
3.90	431,384	893.40	---	---	---	---	5.89	56.28	---	---	---	---	62.17
3.95	437,625	893.45	---	---	---	---	6.00	58.22	---	---	---	---	64.22
4.00	443,867	893.50	---	---	---	---							

...End



LAKE #5 OUTLET STRUCTURE DETAIL

N.T.S.



LAKE #5 EMERGENCY SPILLWAY DETAIL

N.T.S.

Drawing:
07M056-006 CD
Scale
07M056.006
Drawn by:
GJK
Checked By:
Issue Date:
04-04-12

VOICE OF AMERICA PARK ATHLETIC COMPLEX

SECTION 12, TOWN 3, RANGE 2,
WEST CHESTER TOWNSHIP,
BUTLER COUNTY, OHIO

LAKE #5 OUTLET DETAILS



6900 Tylersville Road, Suite A
Mason, OH 45040 - 513.336.6600

Pond Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2011 by Autodesk, Inc. v8

Monday, Apr 16, 2012

Pond No. 5 - Lake #5

Pond Data

Contours -User-defined contour areas. Conic method used for volume calculation. Beginning Elevation = 887.50 ft

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	887.50	00	0	0
0.07	887.57	01	0	0
0.08	887.58	322,667	1,078	1,078
0.50	888.00	326,812	136,370	137,449
1.50	889.00	338,236	332,474	469,923
2.50	890.00	351,020	344,574	814,497
3.50	891.00	356,916	353,929	1,168,426
4.50	892.00	367,142	361,980	1,530,406

Culvert / Orifice Structures

	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 0.00	0.00	0.00	0.00
Span (in)	= 0.00	0.00	0.00	0.00
No. Barrels	= 0	0	0	0
Invert El. (ft)	= 0.00	0.00	0.00	0.00
Length (ft)	= 0.00	0.00	0.00	0.00
Slope (%)	= 0.00	0.00	0.00	n/a
N-Value	= .013	.013	.013	n/a
Orifice Coeff.	= 0.60	0.60	0.60	0.60
Multi-Stage	= n/a	No	No	No

Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	= 0.25	9.67	0.00	0.00
Crest El. (ft)	= 887.50	889.40	0.00	0.00
Weir Coeff.	= 3.00	3.00	3.33	3.33
Weir Type	= Rect	Rect	---	---
Multi-Stage	= No	No	No	No
Exfil.(in/hr)	= 0.000 (by Wet area)			
TW Elev. (ft)	= 0.00			

Note: Culvert/Orifice outflows are analyzed under inlet (ic) and outlet (oc) control. Weir risers checked for orifice conditions (ic) and submergence (s).

Stage / Storage / Discharge Table

Stage ft	Storage cuft	Elevation ft	Clv A cfs	Clv B cfs	Clv C cfs	PrfRsr cfs	Wr A cfs	Wr B cfs	Wr C cfs	Wr D cfs	Exfil cfs	User cfs	Total cfs
0.00	0	887.50	---	---	---	---	0.00	0.00	---	---	---	---	0.000
0.01	0	887.51	---	---	---	---	0.00	0.00	---	---	---	---	0.000
0.01	0	887.51	---	---	---	---	0.00	0.00	---	---	---	---	0.001
0.02	0	887.52	---	---	---	---	0.00	0.00	---	---	---	---	0.002
0.03	0	887.53	---	---	---	---	0.00	0.00	---	---	---	---	0.004
0.04	0	887.54	---	---	---	---	0.01	0.00	---	---	---	---	0.005
0.04	0	887.54	---	---	---	---	0.01	0.00	---	---	---	---	0.006
0.05	0	887.55	---	---	---	---	0.01	0.00	---	---	---	---	0.008
0.06	0	887.56	---	---	---	---	0.01	0.00	---	---	---	---	0.010
0.06	0	887.56	---	---	---	---	0.01	0.00	---	---	---	---	0.012
0.07	0	887.57	---	---	---	---	0.01	0.00	---	---	---	---	0.014
0.07	108	887.57	---	---	---	---	0.01	0.00	---	---	---	---	0.014
0.07	216	887.57	---	---	---	---	0.01	0.00	---	---	---	---	0.015
0.07	324	887.57	---	---	---	---	0.02	0.00	---	---	---	---	0.015
0.07	431	887.57	---	---	---	---	0.02	0.00	---	---	---	---	0.015
0.08	539	887.57	---	---	---	---	0.02	0.00	---	---	---	---	0.016
0.08	647	887.58	---	---	---	---	0.02	0.00	---	---	---	---	0.016
0.08	755	887.58	---	---	---	---	0.02	0.00	---	---	---	---	0.016
0.08	863	887.58	---	---	---	---	0.02	0.00	---	---	---	---	0.017
0.08	971	887.58	---	---	---	---	0.02	0.00	---	---	---	---	0.017
0.08	1,078	887.58	---	---	---	---	0.03	0.00	---	---	---	---	0.032
0.12	14,715	887.62	---	---	---	---	0.05	0.00	---	---	---	---	0.050
0.16	28,353	887.66	---	---	---	---	0.07	0.00	---	---	---	---	0.070
0.21	41,990	887.71	---	---	---	---	0.09	0.00	---	---	---	---	0.093
0.25	55,627	887.75	---	---	---	---	0.12	0.00	---	---	---	---	0.117
0.29	69,264	887.79	---	---	---	---	0.14	0.00	---	---	---	---	0.143
0.33	82,901	887.83	---	---	---	---	0.17	0.00	---	---	---	---	0.172
0.37	96,538	887.87	---	---	---	---	0.20	0.00	---	---	---	---	0.201
0.42	110,175	887.92	---	---	---	---	0.23	0.00	---	---	---	---	0.232
0.46	123,812	887.96	---	---	---	---	0.27	0.00	---	---	---	---	0.265
0.50	137,449	888.00	---	---	---	---	0.35	0.00	---	---	---	---	0.349
0.60	170,696	888.10	---	---	---	---	0.44	0.00	---	---	---	---	0.439
0.70	203,944	888.20	---	---	---	---	0.54	0.00	---	---	---	---	0.537
0.80	237,191	888.30	---	---	---	---	0.64	0.00	---	---	---	---	0.640
0.90	270,439	888.40	---	---	---	---							

Continues on next page...

Lake #5

Stage / Storage / Discharge Table

Stage ft	Storage cuft	Elevation ft	Clv A cfs	Clv B cfs	Clv C cfs	PrfRsr cfs	Wr A cfs	Wr B cfs	Wr C cfs	Wr D cfs	Exfil cfs	User cfs	Total cfs
							0.75	0.00	---	---	---	---	0.750
1.00	303,686	888.50	---	---	---	---	0.87	0.00	---	---	---	---	0.865
1.10	336,934	888.60	---	---	---	---	0.99	0.00	---	---	---	---	0.986
1.20	370,181	888.70	---	---	---	---	1.11	0.00	---	---	---	---	1.111
1.30	403,428	888.80	---	---	---	---	1.24	0.00	---	---	---	---	1.242
1.40	436,676	888.90	---	---	---	---	1.38	0.00	---	---	---	---	1.378
1.50	469,923	889.00	---	---	---	---	1.52	0.00	---	---	---	---	1.518
1.60	504,381	889.10	---	---	---	---	1.66	0.00	---	---	---	---	1.662
1.70	538,838	889.20	---	---	---	---	1.81	0.00	---	---	---	---	1.811
1.80	573,295	889.30	---	---	---	---	1.96	0.00	---	---	---	---	1.964
1.90	607,753	889.40	---	---	---	---	2.12	0.92	---	---	---	---	3.036
2.00	642,210	889.50	---	---	---	---	2.28	2.59	---	---	---	---	4.874
2.10	676,668	889.60	---	---	---	---	2.45	4.76	---	---	---	---	7.209
2.20	711,125	889.70	---	---	---	---	2.62	7.33	---	---	---	---	9.949
2.30	745,582	889.80	---	---	---	---	2.79	10.25	---	---	---	---	13.04
2.40	780,040	889.90	---	---	---	---	2.96	13.48	---	---	---	---	16.45
2.50	814,497	890.00	---	---	---	---	3.14	16.99	---	---	---	---	20.13
2.60	849,890	890.10	---	---	---	---	3.33	20.76	---	---	---	---	24.08
2.70	885,283	890.20	---	---	---	---	3.51	24.77	---	---	---	---	28.28
2.80	920,676	890.30	---	---	---	---	3.70	29.00	---	---	---	---	32.71
2.90	956,069	890.40	---	---	---	---	3.90	33.46	---	---	---	---	37.36
3.00	991,462	890.50	---	---	---	---	4.09	38.13	---	---	---	---	42.22
3.10	1,026,854	890.60	---	---	---	---	4.29	42.99	---	---	---	---	47.28
3.20	1,062,247	890.70	---	---	---	---	4.50	48.04	---	---	---	---	52.54
3.30	1,097,640	890.80	---	---	---	---	4.70	53.28	---	---	---	---	57.98
3.40	1,133,033	890.90	---	---	---	---	4.91	58.71	---	---	---	---	63.62
3.50	1,168,426	891.00	---	---	---	---	5.12	64.30	---	---	---	---	69.42
3.60	1,204,624	891.10	---	---	---	---	5.34	70.05	---	---	---	---	75.39
3.70	1,240,822	891.20	---	---	---	---	5.56	75.97	---	---	---	---	81.53
3.80	1,277,020	891.30	---	---	---	---	5.78	82.05	---	---	---	---	87.82
3.90	1,313,218	891.40	---	---	---	---	6.00	88.27	---	---	---	---	94.27
4.00	1,349,416	891.50	---	---	---	---	6.23	94.65	---	---	---	---	100.88
4.10	1,385,614	891.60	---	---	---	---	6.46	101.18	---	---	---	---	107.63
4.20	1,421,813	891.70	---	---	---	---	6.69	107.85	---	---	---	---	114.53
4.30	1,458,011	891.80	---	---	---	---	6.92	114.66	---	---	---	---	121.58
4.40	1,494,209	891.90	---	---	---	---	7.16	121.62	---	---	---	---	128.78
4.50	1,530,406	892.00	---	---	---	---							

...End



Water Quality Volume

Project: Voice of America Park Designed By: GJK Date: 4/16/12
 Job No.: 07M056.006 Checked By: _____ Date: _____
 Basin ID: WQ Basin (Lake #1) Revised By: _____ Date: _____

Required Water Quality Volume

$$WQ_v = P C A / 12$$

Site Drainage Area (A) = 24.30 acres (To Basin) $WQ_v =$ 0.304 acre-ft.
 Rainfall Depth (P) = 0.75 in. Sediment Storage Allowance = -25 %
 Sediment Storage Allowance = -0.08 Ac-ft
 Runoff Coefficient (C) = 0.2 **Total WQ_v = 0.228 Ac-ft**
 = 9,924 cu.ft.

Water Quality Release Rate

$$Q_{wqv} = \text{Total } WQ_v / RT$$

Required Retention Time (RT) 24 hours

$$Q_{wqv} = \underline{0.115 \text{ cfs}}$$

Provided Retention Time (PT) 44.21 hours

Water Quality Outlet Orifice

Contour Areas

	Elevation ft	Area ft ²	Volume ft ³	Cum. Vol. ft ³	Elevation at V	Storage at Elev
Basin Inv. =	884.50	79,803	0.00	0.00		
Contour 1 =	885.00	88,336	42034.75	42034.75	884.62	9923.51
Contour 2 =	886.00	87,471	87903.50	129938.25		
Contour 3 =	887.00	92,703	90087.00	220025.25		

$$Q = C L H^{3/2}$$

$C_d =$ 3.00
 $L =$ 6.00 in
 $H =$ 1.44 in
 $Q =$ 0.062 cfs



Water Quality Volume

Project: Voice of America Park Designed By: GJK Date: 4/16/12
Job No.: 07M056.006 Checked By: Date:
Basin ID: WQ Basin (Lake #2) Revised By: Date:

Required Water Quality Volume

$$WQ_v = P C A / 12$$

Site Drainage Area (A) = 16.70 acres (To Basin) $WQ_v = 0.209$ acre-ft.
Rainfall Depth (P) = 0.75 in. Sediment Storage Allowance = -25 %
Runoff Coefficient (C) = 0.2 Sediment Storage Allowance = -0.05 Ac-ft

$Total WQ_v = 0.157$ Ac-ft
= 6,820 cu.ft.

Water Quality Release Rate

$$Q_{wqv} = Total WQ_v / RT$$

Required Retention Time (RT) 24 hours

$Q_{wqv} = 0.079$ cfs

Provided Retention Time (PT) 79.88 hours

Water Quality Outlet Orifice

Contour Areas

	Elevation ft	Area ft ²	Volume ft ³	Cum. Vol. ft ³	Elevation at V	Storage at Elev
Basin Inv. =	887.70	54,989	0.00	0.00		
Contour 1 =	888.00	80,959	20392.20	20392.20	887.80	6819.86
Contour 2 =	889.00	110,891	95925.00	116317.20		

$$Q = C L H^{3/2}$$

$C_d = 3.00$
 $L = 3.00$ in
 $H = 1.20$ in
 $Q = 0.024$ cfs



Water Quality Volume

Project: Voice of America Park Designed By: GJK Date: 4/4/12
Job No.: 07M056.006 Checked By: Date:
Basin ID: WQ Basin (Lake #3) Revised By: GJK Date: 4/14/12

Required Water Quality Volume

$$WQ_v = P C A / 12$$

Site Drainage Area (A) = 63.60 acres (To Basin) $WQ_v = 0.795$ acre-ft.

Rainfall Depth (P) = 0.75 in. Sediment Storage Allowance = -25 %
Sediment Storage Allowance = -0.20 Ac-ft

Runoff Coefficient (C) = 0.2

Total $WQ_v = 0.596$ Ac-ft
= 25,973 cu.ft.

Water Quality Release Rate

$$Q_{wqv} = \text{Total } WQ_v / RT$$

Required Retention Time (RT) 24 hours

$Q_{wqv} = 0.301$ cfs

Provided Retention Time (PT) 1371.37 hours

Water Quality Outlet Orifice

Contour Areas

	Elevation ft	Area ft ²	Volume ft ³	Cum. Vol. ft ³	Elevation at V	Storage at Elev
Basin Inv. =	881.50	148,454	0.00	0.00		
Contour 1 =	882.00	154,399	75713.25	75713.25	881.67	25972.65
Contour 2 =	883.00	164,258	159328.50	235041.75		
Contour 3 =	884.00	147,071	155664.50	390706.25		
Contour 4 =	885.00	183,937	165504.00	556210.25		
Contour 5 =	886.00	207,023	195480.00	751690.25		

$$Q = N C_d A_o (2 g \Delta h)^{1/2}$$

$C_d = 0.61$

$A_o = 0.02 \pi D^2/4$ for circular orifices; $= h * w$ for rectangular orifices

$g = 32.20$ ft/sec²

$Q = 0.005$ cfs

Orifice h = 2.000 inch Orifice w = 0.00 inch (= 0 for circular orifice)
Number of orifices = N = 1

$\Delta h_{avg} = (\text{Elev at V} - \text{Basin Inv})/2 - 1/2 h = 0.00$ ft